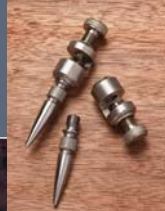


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October 2015 ■ #220

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- Min. stock length: 8"
- Max. cutting depth: 1/8"
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- Table tilt: 10° left, 45° right
- Floor-to-table height: 37 1/2"
- Cutting capacity/throat: 16 1/4" left
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- Cutting capacity/throat: 16 1/4"
- Max. cutting height: 12 1/8"
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49 Mid-century Modern Bookcase

Combining sleek design with simple plywood construction, this bookcase can be used against a wall or as a stylish room divider.

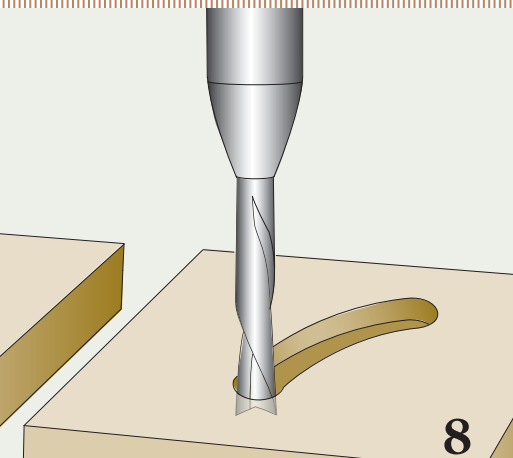
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POPULAR Woodworking MAGAZINE

Number 220, October 2015. *Popular Woodworking Magazine* (ISSN 0884-8823, USPS 752-250) is published 7 times a year, February, April, June, August, October, November and December, which may include an occasional special, combined or expanded issue that may count as two issues, by F+W Media. Editorial and advertising offices are located at 8469 Blue Ash Road, Suite #100, Cincinnati, OH 45236. Unsolicited manuscripts, photographs and artwork should include ample postage on a self-addressed, stamped envelope (SASE); otherwise they will not be returned. Subscription rates: A year's subscription (7 issues) is \$24.95; outside of the U.S. add \$7/year • Canada Publications Mail Agreement No. 40025316. Canadian return address: 2835 Kew Drive, Windsor, ON N8T 3B7 • Copyright 2015 by *Popular Woodworking Magazine*. Periodicals postage paid at Cincinnati, Ohio, and additional mailing offices. Postmaster: Send all address changes to *Popular Woodworking Magazine*, P.O. Box 420235, Palm Coast, FL 32142-0235 Canada GST Reg. #R132594716 • Produced and printed in the U.S.A.

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The Problem with Being a Woodworker

In the last issue, I wrote about being “homeless.” But just days after that issue went to press, I bought a house.

It’s a 1906 three-story brick four-square that retains many of the original architectural features – and it has an awesome (and dry) basement for a workshop (7'-high ceilings!). But there’s been a lot of unfortunate remuddling over the years – much of it due to dividing the building into a two-family dwelling.

I face years of work (and a goodly cash outlay) to bring it back to at least some semblance of its former glory – everything from knocking out walls to rebuilding part of a staircase, from matching missing trim pieces on the front porch to fixing many of the bits still there, to re-outfitting two bathrooms and the kitchen (at least I’m fast at the kitchen cabinet builds now). And that’s just some of the big stuff.

The problem is, because I own lots of tools and know how to use them, I simply can’t bring myself to pay people for what I know can do myself – or for what I think I can teach myself to do.

So instead of calling in a crew of folks who can quickly remove the retrofitted walls and framing and fix the plaster, I’ll be swinging a sledgehammer and wielding a hawk and trowel.

Instead of hiring a skilled craftsman who specializes in building period staircases and can get the work done quickly, I’ll be muddling through it myself on nights and weekends. I

expect it will take months. But I’ll get it done. Eventually.

The only similarity between plumbing remodeled baths and woodworking is that they both use tools. Close enough; I’m (perhaps foolishly) willing to give it a shot.

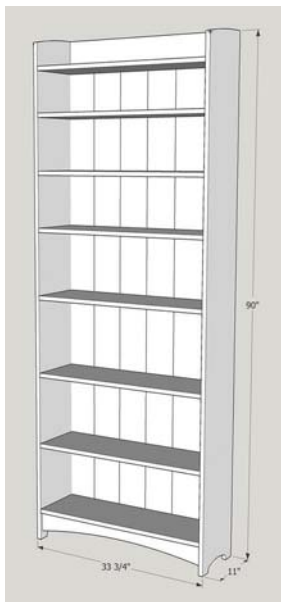
And the kitchen? Well, I now own working appliances; that’ll have to do for the nonce.

But before I get to any of that, I have to 1) put together my shop and 2) get the rest of my boxes unpacked (because otherwise, I’ll go mad). But I’m already out of shelf space.

So to get started (right after I get the shop set up enough), I’m going to tackle a few projects about which I actually feel confident – building (at least) three freestanding bookcases for the “library” (also known as a guest room) and designing and making a desk and shelves for what will become my study...just

as soon as I decide in which room to locate said study.

I expect I’ll be sharing some of that woodworking with you in our pages (who doesn’t like bookcases?!). And in return, if anyone reading wants to share his or her expert plumbing knowledge, shoot me an e-mail. I’m likely to need your help. (I do own a pipe wrench – I find it’s excellent for knocking paint can lids back in place.) **PWM**



Megan Fitzpatrick

ILLUSTRATION BY THE AUTHOR

OCTOBER 2015, VOL. 35, NO. 5

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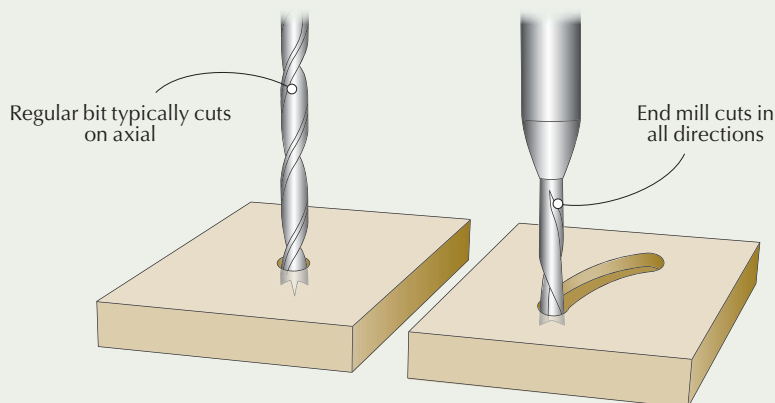
Exactly What is an End Mill?

I am trying to make a wooden backgammon game board and I want to add stringing around the outside box of the game. In the “Federal Bow-front Table” article in the December 2014 issue (#215), author Frank Vucolo noted that he used a 1/32" end mill in a small router with a stock fence when he installed the holly stringing.

My problem? I do not know what an “end mill” is. Is it a bit? And if so, what is meant by the use of a small router with a small fence? Would that be a palm-held (trim) router?

Gary LaRault,
via e-mail

Gary,
An end mill is basically a bit, but its geometry allows it to cut in all directions (a regular bit typically cuts only



on the axial). And yes – the router is a trim router with a stock fence, meaning it’s one Frank bought, not made; they’re generally available from all major trim router manufacturers.

You can also use a rotary cutter if you

prefer that to a trim router, or scratch in the line using a shop-made scratch stock or various tools such as the Groove Cutter from Veritas or the Latta Straight Line Cutter from Lie-Nielsen Toolworks.

Megan Fitzpatrick, editor

Shooting Boards: Start Simple

I am interested in buying a shooting plane and building a shooting board.

My question is, should I build a straight shooting board or a ramped shooting board?

As I understand it, the advantage of a ramped shooting board is twofold. First, it allows more even use of the plane blade than a straight shooting board. Second, a ramped board takes a much easier cut of the wood.

Because the blade of the plane I am considering is already skewed, I am not sure what the effect of using it on a ramped shooting board would be. It would use more of the blade, but I have no idea what it would do in terms of the ease of the cut. Any advice?

Mark Hagy,
Sunbury, Pennsylvania

Mark
Historically, most shooting boards were disposable items built from available materials, then modified and used until they were chewed up or unreliable.

So I see very little need for a ramped shooting board. They require significantly more work to construct, and their only real advantage is the ramp spreads out the wear on the blade. If you know how to sharpen, then this is a trifling advantage. In any case, shooting board planes should be kept sharp. So I’m always sharpening mine anyway.

Simple shooting boards take about 20 minutes to construct and last about five years. I’d try one of those and see if you like it. Then decide in five years if you think a complex ramped board is worth the effort.

Christopher Schwarz,
contributing editor

Aluminum Planes: Yea or Nay?

I was recently given a Stanley A6 hand-plane. The condition is pretty ratty; the sole of the aluminum body has light gouges as if it has struck something. However, nothing snags on the bottom.

I sharpened the iron, and the A6 does a great job, from hogging off 0.015"-thick shavings to very, very thin

shavings. The blade has a nice camber, which makes me believe the previous owner(s) actually used this foreplane. But the finish on the cap iron is ruined, and there is slight corrosion all over, suggesting poor storage. The bottom of the casting is as flat as I have ever seen on a longer plane like this one.

I might keep this as a user, but I have to wonder if it will be durable, due to the aluminum casting. What is your experience? Have you ever used one for an extended period?

Al Navas,
St. Joseph, Missouri

Al,
The Stanley aluminum planes were a short-lived experiment in New Britain, Conn., that died out right before World War II. The selling point of the planes was that they were lighter, and so easier to use. They also were significantly more expensive.

On the plus side, the A-series planes are indeed lighter, which is an advantage with rough foreplane work. And alumi-

CONTINUED ON PAGE 10

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num does not rust in the same way as iron.

However, the aluminum soles and side-walls are easily dinged and gouged, so you need to keep an eye on those areas and keep burrs, etc. filed down so they don't mar your work.

Also, the aluminum can mark the work if the tool has not been used for some time (much the same way a bronze plane will). It's not a big deal, but worth noting.

So feel free to use the tool if it works well. They are not especially collectible, so it's best to put the thing to work, warts and all.

Christopher Schwarz,
contributing editor

Cutting Steam Hose to Length

I read with interest Christopher Schwarz's Tool Test in the June issue (#218) about the Earlex WS77 steam generator, and the trouble he had with the length of the hose—and Chris noted that there is no way to easily shorten it.

Steam-rated hose has a wire braid inside (sometimes two layers), making it difficult to cut. You can cut it yourself by using a vise and a hacksaw, but cutting steam hose with a hacksaw usually isn't pretty.

You can buy manual cutters online that are designed to cut 1/2" and smaller hydraulic hose. The cutters look like a tree-limb cutter and will set you back about \$60—too much to spend on one cut, I think.

If you do use a hacksaw to cut the hose, use a pair of wire cutters to trim any long wires protruding from the end. Above all, wear gloves and watch out for those little wire blood testers sticking out from the end—you get bit once, you'll remember.

As a journeyman pipefitter for 38 years, I've cut all manner of hoses. We use a special (expensive) braided hose-cutting machine to do the job. But going through all the types and styles of hose we use, the specialized tool makes it much easier to do the job. But for one cut, try the hacksaw.

Keith J. Whitmore,
Duquesne, Pennsylvania

Can Shellac Go Over Glaze?

My brother and his wife are having a baby later this year, so I am building a rocking bassinet for them out of cherry.

In his April 2002 article in *American Woodworker* (issue #93), Tim Johnson calls for sealing the wood with shellac, adding glaze on top of the shellac, then film-finishing with a couple layers of polyurethane.

Is there a problem with film finishing with shellac on top of the glazed surface? Will shellac make the glaze melt and run, whereas polyurethane will not?

Owen O'Neill,
Stillwater, Oklahoma

Owen,
There's no problem at all using shellac as a finish over shellac sealer and glaze. This was done, in fact, through most of the early 20th century, until lacquer replaced shellac as the preferred finish in furniture factories.

Actually, the risk of problems is greater with polyurethane over the glaze because they both thin with the same thinner, mineral spirits. Shellac thins with alcohol, so it won't have any "dissolving" effect on the glaze. I'd still let the glaze dry fully before applying the shellac. (I'm assuming you're using an oil-based glaze, but you won't have any problem with water-based glaze either.) PWM

Bob Flexner, contributing editor

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— Christopher Schwarz

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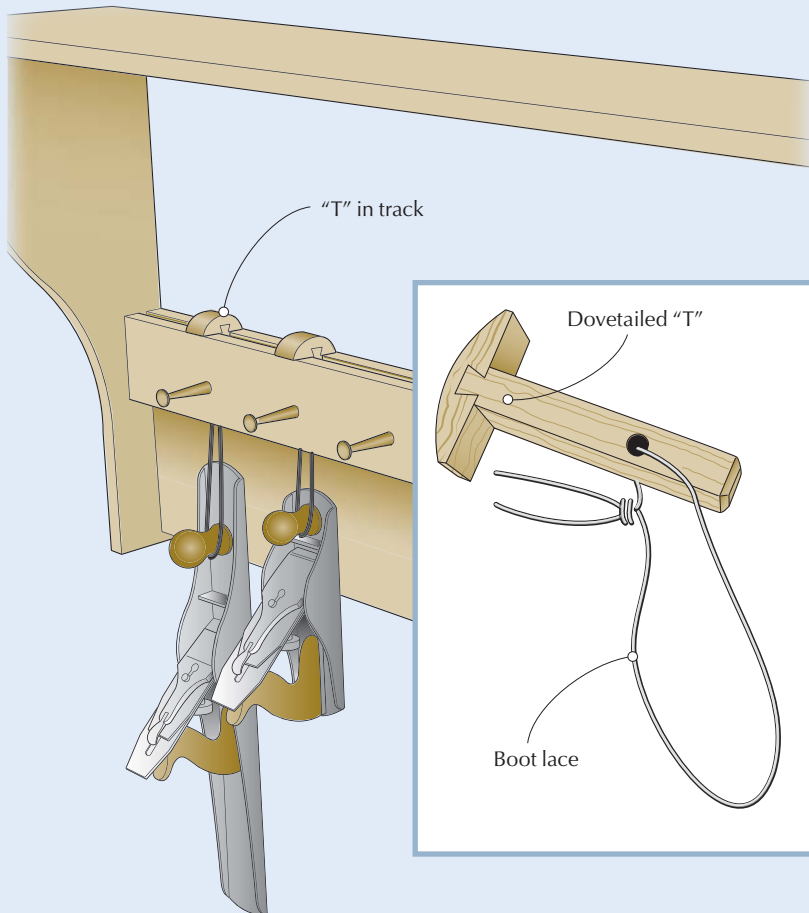
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THE WINNER:

Planes Fit to a Tee



After building an “I Can Do That: Tool Rack” (April 2011, issue #189), I wanted to have my planes accessible on the rack as well. So here’s my solution.

Cut two pieces of oak into $\frac{1}{2}$ " x $\frac{3}{4}$ " pieces, one 2" long and the other $3\frac{3}{8}$ " long.

Form a “T” by cutting a sliding dovetail with the tail end on the long piece and the pin on the short piece.

After fitting the dovetail, I shaped the top of the “T” for aesthetics by rounding it over. But be sure not to make the top part of the “T” too thin because that might weaken the hanger and cause it to fail under heavy load.

Next, drill a $\frac{1}{4}$ " hole $1\frac{1}{8}$ " from the bottom of the “T” on the $\frac{1}{2}$ " face.

Cut a piece of cordage (I used boot laces) 15" long and tie a knot to secure it (adjust the length as necessary for various sizes of planes). Apply a coat of boiled linseed oil or other desired finish.

Now simply insert the “T” into the $\frac{1}{2}$ "-wide slot in the tool rack, and you have a great hanger for your planes.

While these support even my largest plane, a No. 7 jointer, I urge you to test your hangers before placing your cherished tools on them.

Aaron Henderson,
Fuquay-Varina, North Carolina

Simple & Effective Shop Heat For Moderate Climes

Lately I’ve noticed a lot of woodworking magazine articles and inquiries about how to heat a shop. It’s of special interest in the northern climes where cold winters are a big problem for garage and basement shops requiring big and expensive solutions.

But in areas where the temperature drop is not so extreme, here’s a simple, inexpensive solution to make working in a chilly shop more comfortable.

Infrared heat lamps (bulbs) suspended above workstations can take the chill off. Infrared heat lamps transfer heat by radiation, which heats objects directly, but not the air...think, the sun. Also, the “clear” infrared heat lamps offer a bonus feature in that they can double as task lighting.

Be sure that you screw the heat lamp into a porcelain socket rated at 120 volts and 250 watts minimum.

A variety of infrared heat lamps are available online for about \$10 each in the 250-watt size.

John Cusimano,
Lansdale, Pennsylvania

Fuel Hose as Depth Stop

Most woodworkers have at some point needed to mark a drill bit to control hole depth.

Tape is a common solution, but has drawbacks, especially if there are a number of holes to drill.

Depth stops that secure to the bit with a screw are available, but often don’t work well with smaller size bits.

An effective but inexpensive solution is available at the auto parts store: a vacuum or fuel hose. These are sold in many different sizes, and one can usually be found that will slip easily on and off the bit, yet still stay put in use.

If too much force is applied, the tubing will mark the work, but the mark sands off easily.

Harry Strawbridge,
Atwater, California

'Beater' Attachment for a Hand Mixer as Shop Helper

My wife was throwing away an old hand-held mixer. I noticed the beater attachments and thought they might come in handy in the shop, so I decided to give them a try.

I chucked one of the beaters into my drill and, with the drill running at low speed, used it to mix some polyurethane (even though the directions on the can direct you to stir). It would also be effective for mixing paint.

It works great, and I feel good about having recycled at least part of the mixer.

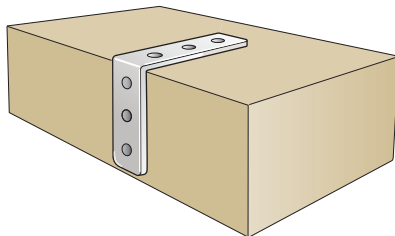
Lenny Harrison,
Browns Mills, New Jersey

Squaring on the Cheap

Instead of spending good money on an expensive marking tool, use an angle bracket to mark a square line at two consecutive edges of a board.

Paint it a bright color and keep it with your other marking tools.

Les Beeckman,
Saginaw, Michigan



Jig for Honing Narrow Chisels

I use a honing guide that clamps from above and below. This works well for wide chisels, but for narrow chisels it can be a challenge not to bump it out of square or even mount it in the guide.

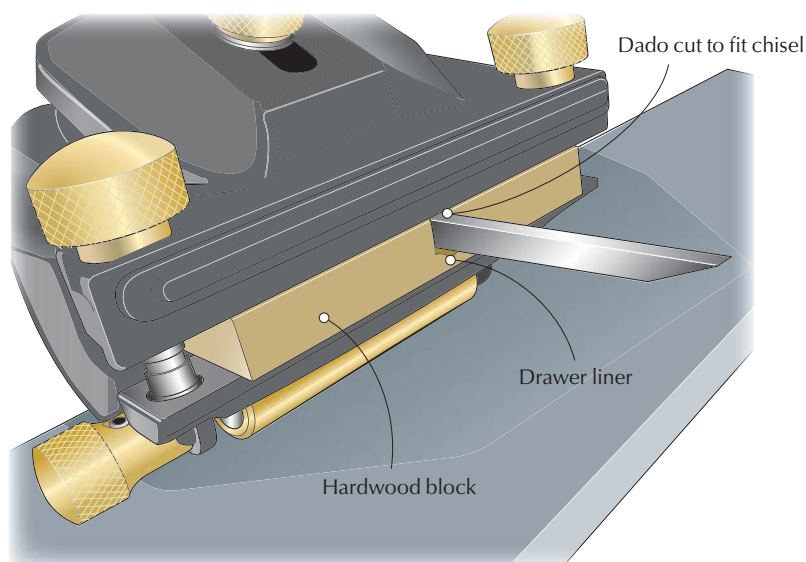
To help with narrower chisels, I use a piece of wood that is thicker than my chisel, but still fits in the honing guide.

I cut a dado that fits the chisel tight from side to side, but is slightly deeper than its height. In the bottom of the dado I put some drawer liner to raise

the chisel proud of the top of the piece of wood by about $\frac{1}{16}$ ". (Cork or foam would work for this too, as long as it can be compressed and is not slick.)

Then, I put all of this in my honing guide. The top and bottom clamp of the honing guide compress the chisel and register on the tool as well as the piece of wood. This helps to secure my narrow chisels square to get a consistent, keen edge. **PWM**

Dean Vande Griend,
Story City, Iowa



Greasy Carpet: Slick Trick for Top-notch Tool Performance

Among the most important tools in my shop is a small piece of leftover carpet (about 3" x 12") that's impregnated with tallow.

I seldom go more than about a dozen or so strokes with a plane, chisel, drill bit or saw without a pass of the tool over the carpet.

The tallow makes a huge difference with my ease of motion and the performance of the tool.

Jim Tolpin,
Port Townsend, Washington

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‘The Secret Mitre Dovetail’

David Charlesworth’s new video is groundbreaking instruction.

The “secret miter” dovetail is considered the most elegant and difficult of all the dovetail joints to make. As a result, many woodworkers hesitate to even attempt the joint, which can seamlessly wrap the grain around a furniture carcass to a beautiful effect.

In his latest DVD, English craftsman David Charlesworth – best known for his “ruler trick” for sharpening – dissects the secret miter joint to present it as one that almost any woodworker can make with just a little care.

Like all of David’s DVDs, “The Secret Mitre Dovetail” is an extremely detailed presentation of its topic. No aspect of the joint is too small to consider. And this particular DVD uses razor-sharp macro photography, which allows you to see exactly what is going on as the tools enter the wood.

What I quite like about David’s DVDs is that he presents the absolute finest work imaginable. While some might see it as fussy or overly precious, I take a different view. Any woodworker who watches this DVD will come away with some fantastic approaches to layout, sawing, chopping and paring – even if they never cut a secret miter dovetail.

In particular, David offers some useful insights that I’ve never seen discussed, including:

- How to easily set your chisel perfectly horizontal and properly angled when paring a dovetail.
- How to use two parallel baselines

‘The Secret Mitre Dovetail’

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Secrets revealed. David Charlesworth’s new video offers great tips and techniques for layout, sawing, chopping and paring dovetails – even if you never intend the joint to be secret.

in your dovetailing to improve the joint’s accuracy.

■ Using a small scrap to reliably undercut portions of the joint to 1° – a trick I will begin using immediately.

■ Plus, how to assess the fit of the joint using a bench light to show areas that need paring before you even do a test-fit.

Personally, I cut this dovetail joint differently than David. He saws close to the line and finishes with a chisel. I saw directly on my lines. Yet, I thoroughly enjoyed seeing David’s approach because I can see cases where his methods would save me from making an error or would improve some of the fiddly parts of the joint.

For example, the DVD ends with David showing how to glue up the joint with ingenious clamping blocks that help close the long miter and keep the case square – the blocks are a much better clamping approach than I was using.



The only criticism you’ll possibly hear about this DVD is that David’s teaching style is slow. Perhaps I’m slow myself, but I like his pace because it allows for some of the more difficult concepts to sink in – I never had to back up the video and watch the tricky bits again.

So if you have an open mind about different approaches to the craft, I think you’ll greatly enjoy this new DVD – it’s well worth your time and the minimal expense.

— Christopher Schwarz

CONTINUED ON PAGE 16

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Veritas Stainless Steel Trammel Points

These clever stainless steel trammel points (for scribing large arcs and circles) from Veritas work a little differently than my vintage set, which fit only on a fixed-sized beam. The narrow-bodied heads are open on one side, and can thus be attached to any flat piece of material up to 1/4" in thickness – so, a yardstick, wood or metal rule, or any thin offcut in the scrap bin. Caveat: When attached to a metal rule, the head slips unless you crank the screw down hard – but the nicely knurled grip allows for a good hold to do so.

Veritas Trammel Points

Veritas ■ leevalley.com or
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Street price ■ \$25

■ VIDEO See the Veritas trammel points in action on our web site.

Price correct at time of publication.

Also unlike my vintage pair, which has needle-like points, the tips on these trammel points are for the most part rounded, with a small, sharp point at only the very bottom. I'll be interested to see how long that holds up under use, but so far, I've had no trouble scribing a clean arc on any of the five domestic hardwoods I've tried (nor on Eastern white pine). Lee Valley marketing states the tool effectively scribes on aluminum, brass, bronze and mild steel, as well as wood, though I've not tried them on said materials.

The tips are removable, so the heads can double as stops on a square – without risk of puncture – or what have you for marking repetitive angles (which might come in handy if I end up having to cut stringers as I rebuild part of a staircase).

My only complaint – if you can really call it a complaint – is that at the



moment, no pencil attachment is available (though I've asked the designers at Veritas about it). How sweet would it be to have the option of screwing a graphite point into one of the heads to mark a pencil line?

—Megan Fitzpatrick

Sterling Tool Works Stainless Steel French Curves

I like using French curves for laying out hyperbolas, ellipses and parabolas when designing furniture details. These curves are not static arcs – they are segments of the Euler spiral – and so the shapes they create have more spring and life.

The typical set of French curves consists of three small plastic layout tools that are suitable for small pieces of woodwork or small scaled layouts. What I've struggled to find are larger French curves that allow me to add curves directly to full-sized furniture

work or full-size drawings.

Also, I hate plastic layout tools (that's a personal problem).

Sterling Tool Works has just released a set of stainless steel curves that are perfectly sized for furniture-makers. The largest is 18" long; the smaller ones are about 8" and 9" long. These sizes are fantastic for laying out curves for chairs or full-size casework.

Each tool is .06" thick, has a matte finish and its corners have been eased during manufacturing so they are a pleasure to use and scribe against. Because of their thickness, they also don't feel flimsy like plastic French curves.

Finally, I'm most pleased that the



working edges of these curves are not rabbeted like they are on plastic curves. The rabbet is fine for sketching, but is not ideal for precise layouts.

The Sterling French curves are \$70 for the set, but they will be the last set of curves you will ever buy. Highly recommended. PWM

—CS

Sterling French Curves

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■ BLOG Read more about these curves on our web site.

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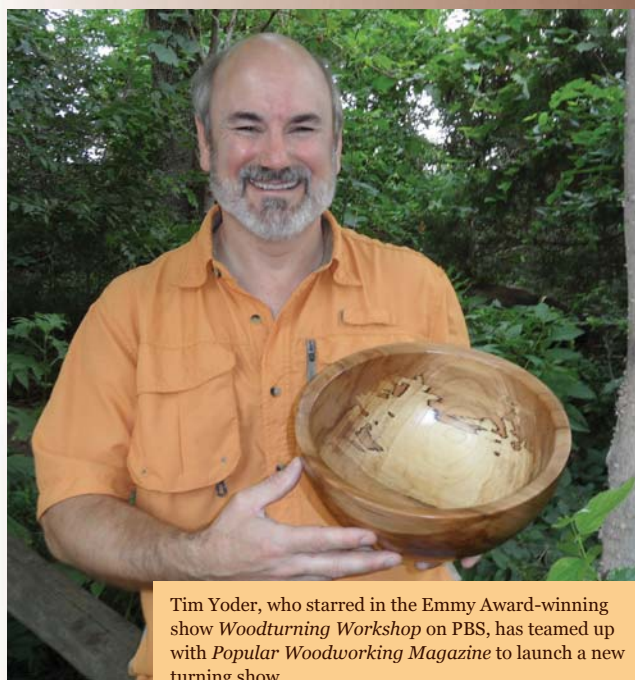
Popular Woodworking Magazine has teamed up with well-known PBS star Tim Yoder to launch a new online video show, filled with expert and friendly advice that will teach you how to become a better woodturner.

In each 30-minute episode, Tim takes you through the process of making beautiful woodturning projects, from wine stoppers and duck calls to platters and bowls. Along the way, you'll learn his favorite turning tips and techniques, and he'll offer reviews of the latest lathe tools, chucks and accessories to help you determine the best products to buy.

Whether you're an experienced woodturner who wants to improve your skills or you're new to the hobby and want to learn basic woodturning, *Woodturning with Tim Yoder* is a show you'll want to watch.

Visit **www.popularwoodturning.com** every Saturday for the latest episode of *Woodturning with Tim Yoder*.

This show is brought to you by: Easy Wood Tools, Robust Lathes, Titebond Glue, Thompson Lathe Tools, Woodworkers Emporium, and Rikon Power Tools.



Tim Yoder, who starred in the Emmy Award-winning show *Woodturning Workshop* on PBS, has teamed up with *Popular Woodworking Magazine* to launch a new turning show.

Designer Profile: Dan Mosheim

His creative process starts with pencil and moves on to CAD and CNC.

I first stumbled onto Dan Mosheim about six years ago through his eclectic blog, “Dorset Custom Furniture—A Woodworkers Photo Journal” (dorsetcustomfurniture.blogspot.com).

It’s primarily about building and designing furniture, but it’s also a peek into Dan’s interest in art and literature, his forays into pottery, along with a bit of life in rural Vermont with wild turkeys strutting in the back garden and trout fishermen in local streams.

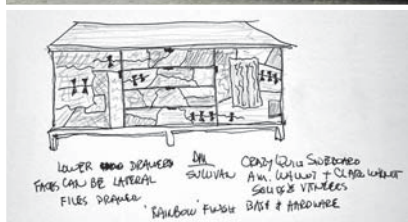
Dan’s interests are as varied as the furniture coming out of his shop, and it’s obvious that his work is infused with this genuine appreciation for life. A flock of colorful mallard ducks landing in his backyard pond may inspire the decorative inlay for a table or bed.

For much of history, what elevated an artisan was the ability to design and build at a very high level. It was assumed that an artisan who could build a library building or a library table was also capable of designing it.

Our word “architect” comes from the Greek word “architekton,” a combination of the root “archi” (chief), and “tekton” (builder). For more than three decades, Dan has been the embodiment of that. Yet Dan is not some throwback. Although his designs are informed by an appreciation for woodworking tradition, he’s firmly rooted in the present, not only in his designs, but also in the technology to which he avails himself.



Family affair. Dan (center) sometimes works with his sons, Will (left) and Sam.



Inspiration everywhere. This claro walnut sideboard was inspired by “crazy quilt” pattern found in vintage quilts. The sideboard began as a simple concept sketch before the design was refined with CAD.

Blended Approach

When it comes to technology, folks tend to line up in two different camps. There are traditionalists who want to seal the old ways in amber, and the futurists who embrace technology and often jettison the past. Dan sidesteps both and instead embraces the best of tradition while remaining open to new ideas.

His workshop is nestled in the forested hills of Vermont and he’s rooted in a practical outlook that he summed up by one of his favorite quotes from David Pye, the influential furniture design professor and author.

“Where the problem is old, the old solutions will nearly always be best (unless a new technique has been introduced) because it is inconceivable that all the designers of 10 or 20 generations will have been fools.”

Perhaps it’s that practical embrace

of both old and new that explains the impressive array of furniture Dan and his crew produce at his shop, Dorset Custom Furniture.

That output includes stunning reproductions of classic American period pieces alongside contemporary and modern studio designs infused with his flair for the spontaneous and the beautiful.

Yin & Yang

The scope of his work covers small artfully conceived sculptural pieces to massive corporate boardroom tables that stretch the limits of both wood and machinery to build and move. One week, Dan and his crew might be assembling thin veneer and tiny inlay, while the next, hoisting massive slabs of figured walnut.

Another aspect of Dan’s exploring the intersection between traditional

CONTINUED ON PAGE 20



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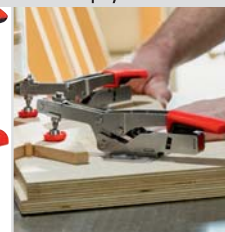
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and contemporary is combining wood furniture with metal structural elements. Both of his sons, Sam and Will, worked in the business and became accomplished builders before moving on to other creative pursuits.

Will builds custom banjos and Sam started up a metal shop in an adjacent building. Sam and Dan often team up to combine the possibilities of wood and steel.

Dan shares that from a design perspective, steel offers not only a contrast in color, but also the possibility of using heavy slabs of thick timber while still lending a design a feeling of lightness.

A Different Take

I was pleasantly surprised to learn how this small custom furniture shop embraces technology. A large CNC router plays a role in much of the work going out to customers – but not for the reasons you might think.

Instead of leaning on the machine as a way to mass produce and indus-



Scaled reality. These small-scale models of tapered cabinets were photographed in a cardboard room setting to help the client visualize the pieces.



Real reality. Once the client approves the design, Dan builds the full-scale pieces.

trialize the shop's output, Dan views it as a tool to increase his creative possibilities. He uses the CNC not only in the production of furniture pieces, but also to quickly work out mockups in MDF. Dan also uses CAD drawings, which play a major part of the design and build process.

He uses the technology to quickly bring ideas together to share with customers, but it's really just an extension of his foundation in drawing and years of building. Technology and tradition fuse together with the best of both worlds.

Practical Design

Dan is quick to point out that he's always drawing and scribbling with pencil and paper. Drawing has always been a constant in the way he works; a way to think through ideas and explore possibilities.

Dan's sketches help him and his crew visualize flowing curves and refine the overall form of a project before moving forward with CAD drawings and mock-ups.

Every finished design, CAD drawing, or CNC program begins with a few (or perhaps many, over time) simple sketches. Ideas bubble up and are quickly captured on paper. Promising ideas quickly translate into a CAD drawing.

Small-scale models are frequently assembled that may include important details, even to the degree that small-scale parts destined to be made of metal are painted a metallic color.

In addition to small scale models, sample blocks of carving or ornament are quickly mocked up on the CNC.

Each of these vignettes come together to help the design come to fruition. Each one – the sketch, the model, the CAD drawing or sample – provides a springboard to push the idea forward as well as guide the actual build.

Because all the work is custom one-off commissions, the emphasis is not on producing detailed prints that leave nothing to chance.

With a grin, Dan describes the build process as moving from one recovery to



Rehearsal in wood. Dan often uses scale models as part of an iterative design process.

the next. Yet beyond the needs within the shop, all these sketches, drawings and models are key for the most important part of the design process; the actual collaboration between Dan and the customer commissioning the work.

On the practical side, his designs are very much driven by the desires and needs of his customers. Much of his success in this regard is in helping each client bring their own thoughts and ideas to fruition.

Dan's easygoing manner and solid grasp of his craft makes for a creative bond with each customer. Every piece coming out of Dorset Custom Furniture is a reflection of that. **PWM**

George is the author of two design DVDs (Lie-Nielsen Toolworks) and author of "By Hand & Eye" (Lost Art Press).

ONLINE EXTRAS

For links to all these online extras, go to:

■ popularwoodworking.com/oct15

BLOG: Read Dan Mosheim's blog.

BLOG: Read more from George R. Walker on his Design Matters blog.

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About This Column



Design Matters dives into the basics of proportions, forms, contrast and composition to give you the skill to tackle furniture design challenges with confidence.

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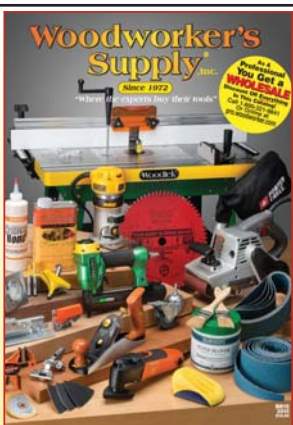
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Slat-back Chair

BY JEFF MILLER



Curves, angles and comfort – this piece will have you sitting pretty.

I've always found making something simple yet refined to be more work than it seems. I suspect that the slat-back chair doesn't exactly look simple to build if you're not a chairmaker. But it is relatively simple in the world of chairs, and it is a great entry into chair-making. It covers all of the basic issues: curves, angles, comfort and structure.

In its refinement, though, it goes well beyond the basics, and gets into some sophisticated joinery that adds considerably to the strength of the chair. This is also a very comfortable chair, which is neither basic nor at all common. And it is a chair that has great presence, especially around a dining table. Simplicity. Comfort. Presence. Not a bad combination.

Pattern Recognition

I don't build my chairs from plans. Instead, I rely on patterns. They define the shape of the legs, and I make sure to include information for all of the joinery that will be cut in the legs. Even though I've provided plans here, it still makes sense to begin by making your own patterns.

I use $\frac{1}{4}$ " plywood for most of my patterns, but there are also advantages to working with $\frac{1}{8}$ " clear plastic. With the latter, you can see the grain as you trace the leg shapes onto your wood. But $\frac{1}{4}$ " plywood is always available in my shop, and it can be smoothed out easily with a handplane (I actually keep a garage-sale block plane handy for use as a plywood plane). You'll want to spend time smoothing the edges of the pattern as well as you can, because any problems will be transmitted down the line to the actual work.

Once your rear leg pattern is cut, spend a few moments on the joinery layout, and mark out the two side-to-side and the one front-to-back mortises on the pattern.

Shapely Legs

Now use your pattern to lay out the rear legs. Try to orient the grain direction so that it flows with the overall shape of the leg. A tendency toward short grain is inevitable, but avoid any situation where the grain will run out across the leg in less than 4½" or 5".

Saw out your legs, being careful to stay just outside the layout lines. Keeping too much distance from the lines does have its penalty; you'll spend more time on the smoothing. Stay as close as you can comfortably and consistently cut.

You could use a router template and a flush-trim-bit setup to start the smoothing process, but I usually start right in with hand tools. Routing will sometimes blow out wood as you cut against the grain when cutting the curves. Even if you manage to avoid that, there will still be plenty of smoothing to do afterward to get rid of the machine marks. So I simply try to cut well at the band saw, and proceed directly to smoothing.

Start with the easy stuff and plane the straight sections on the legs. Then move on to the convex curves, which you should be able to fair and smooth using a block plane or a No. 2 bench plane. Planing curves may take a little practice if you haven't done it before, but it is a great technique for both fairing and smoothing, and it makes quick work of a fairly difficult task.

Finally, smooth out the concave curves with either a straight or curved-sole spokeshave (depending on the curve of the leg). If you have a compass plane, that is also an excellent choice.

You'll find that the transitions between concave and convex curves, as well as the grain direction changes in the hollows of a concave curve, pose the greatest challenges. A scraper can work wonders in these problem areas, but be aware that a scraper does not fair out the curve—it just smooths out the roughness. Don't shy away from sanding, either. A curved sanding block (made from a leg offcut) can do a terrific job on a leg that is proving difficult to smooth.

For now, leave alone the flat section where the side rails will join with the

legs. Flattening this part of the legs is best done just before the mortises are cut for the side rails. And you need to complete more of the chair to determine the exact angle for these mortises.

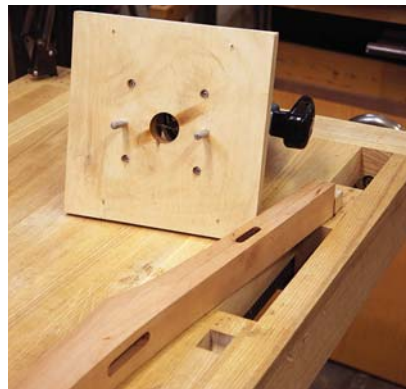
The mortises for the lower back rail are on a straight section of the leg, but aren't parallel to either the front or back of the leg. They run along the centerline of the leg. Cutting them now is a little more work, but it will make dealing with the slats later much easier. You can use a plunge router with a pair of centering pins to cut this mortise, or make up a wedge that you can clamp to the outside of the leg as a guide for routing with a fence (or with a mortising machine).

The upper back rail (the crest rail) is located on a slight curve, and runs tangent to that curve. Here, it will help to make a simple jig to control the mortise positions in the back legs. With this jig, cutting the mortises is as simple as cutting them on a straight section.

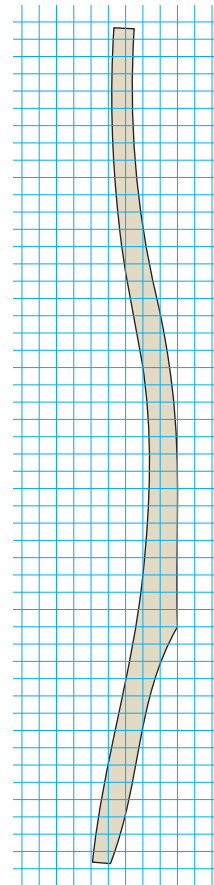
Now prepare the stock for the front legs and the rails on the rest of the chair.

While you're cutting mortises, you can do the front rail mortises in the front legs. Then, cut and fit the tenons for the front rails and the upper and lower back rails.

This will give you the actual widths for the front and the back assemblies of the chair, which you'll use to determine the side rail angle. This is the angle we'll use for the remaining mortises in the front and back legs.



Work from center. Draw a centerline off which to locate the mortises for the lower back rail. I use a router with centering pins for the cuts.



LEG PATTERN
One square = 1"

Angled Mortises

There are many challenging aspects to building a chair, but dealing with the angled joinery ranks right at the top. And this joinery is a little more complex than some. I've opted to go with angled mortises and straight tenons with angled shoulders for this chair.

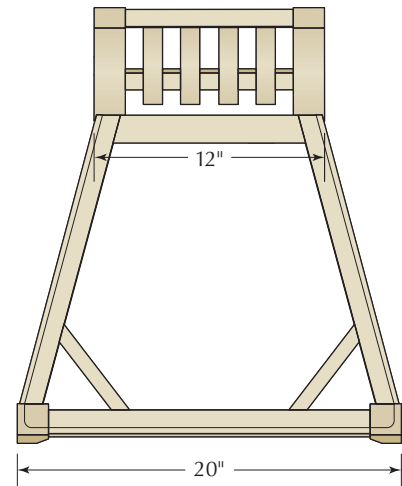
I've made these chairs with regular, right-angled through-mortises and an-



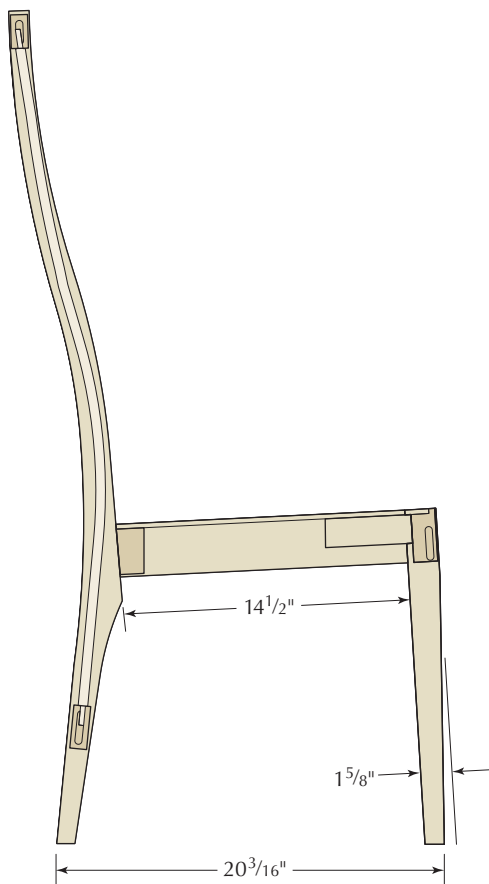
Crest rail. A simple jig to guide a router fence makes quick work of the mortises for the upper back rail.

Slat-back Chair

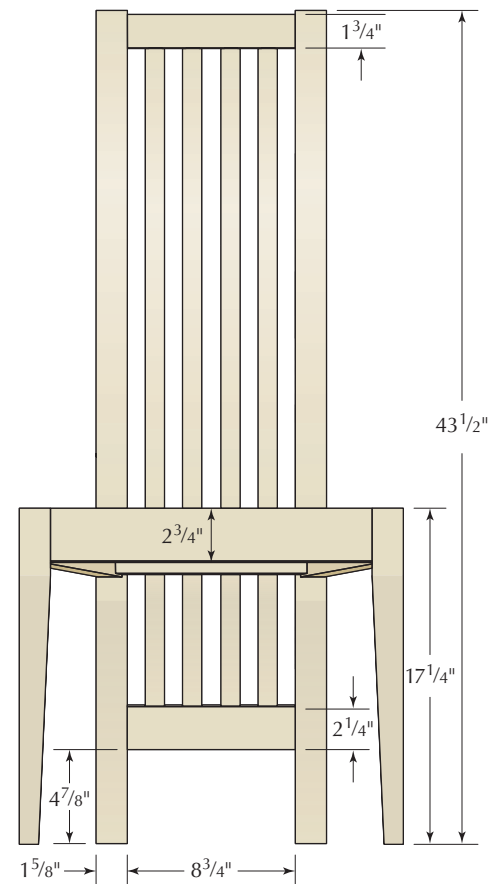
NO. ITEM	DIMENSIONS (INCHES)			MATERIAL	COMMENTS
	T	W	L		
❑ 2 Back legs	1 ⁵ / ₈	4 ¹ / ₂	46	Cherry	
❑ 2 Front legs	1 ⁵ / ₈	1 ⁵ / ₈	17 ¹ / ₄	Cherry	
❑ 3 Front & side rails	1 ¹ / ₄	2 ³ / ₄	20	Cherry	Rough lengths
❑ 1 Lower back rail	⁷ / ₈	2 ¹ / ₄	12	Cherry	Rough length
❑ 1 Crest rail	⁷ / ₈	1 ³ / ₄	12	Cherry	
❑ 1 Seat back rail	1 ¹ / ₂	2 ³ / ₈	12	Cherry	
❑ Slat stock	1 ¹ / ₄	6	42	Cherry	For 4 slats
❑ Corner blocks	1 ¹ / ₄	2 ³ / ₈	12	Hardwood	2 pieces from stock
❑ 1 Seat	³ / ₈	20	20	Plywood	



PLAN



SECTION



ELEVATION

gled tenons in the past, but the wedged through-tenon between the back legs and side rails loosened up on a few occasions. With angled mortises, and the rail at the back of the seat screwed to the side rails, this joint gets significant additional reinforcement.

Getting a handle on this complex joinery is mostly a question of main-

taining a methodical approach. Start by working out the angle for the side rails with a full-size drawing of the plan view of the chair between the legs.

Note that I'm not giving you the angle (or the length of the rail). As a chair-maker, it is better to work that out for yourself from a drawing. (See "Determining the Side Rail Angle" on page 30.)

This angle will then work for the side-rail mortises in both the front and rear legs. Save your drawing (I usually do it on a piece of plywood and set it aside). You'll need it later to determine the length of the side rails.

There are many ways to actually cut the angled mortises. The simplest approach is to hold the leg at the ap-

appropriate angle, then cut however you would cut a straight mortise. This might mean making a pair of wedges (glue some sandpaper to the faces for a solid grip) for positioning the leg in a slot mortiser or hollow-chisel mortiser, or tilting the worksurface to the desired angle on a machine that has this capability. Or, you can build my router mortising jig (see “Shop-Made Mortise Jig” at right); it accommodates both angled and straight mortises, and has the advantage of allowing you to rout the flat for the side rail on the rear leg as well.

Create the 90° flat for the side rail on both of your rear legs before cutting the through-mortises. To do this, use your leg pattern to set three positioning stops to locate the legs precisely on the vertical face of the jig, aligning the flat on the pattern with the top of the hinged plywood face. Screw two of the stops to the plywood to register the front edge of the leg near the top and the bottom, and another stop to register the very bottom of the leg. This will ensure that all of the legs line up perfectly where it matters. Then rout the flat surface true, with a 1/2" straight bit or upcut spiral.

Now set the mortising jig to the desired angle with a wedge screwed into place to secure it to the jig. Install a 1/2"-diameter 4" (overall) straight bit.

Set up the router with a fence and auxiliary wood fence that will slide smoothly (without any slop) in your jig's wooden track. Then, set the fence so that the cut will be 1/8" from the outside face of the leg.



Multi jig. This simple jig guides a router fence to make quick work of the flats, and of the mortises for the side rails.

Set stops on the top of the jig to limit the router's travel to create a 2 1/2"-long mortise.

Now plunge rout the mortise in very small increments, no more than 1/16" at a time. This will keep the router from overworking and vibrating excessively, which would give you a larger mortise.

This setup will only work for one of the legs for the chair, because the legs are symmetrical, not identical. For the opposite leg, you'll have to flip the legs end-for-end in the jig, and re-set the stops. If, however, you're making multiples, cut the mortises for all the like legs before resetting for the other side.

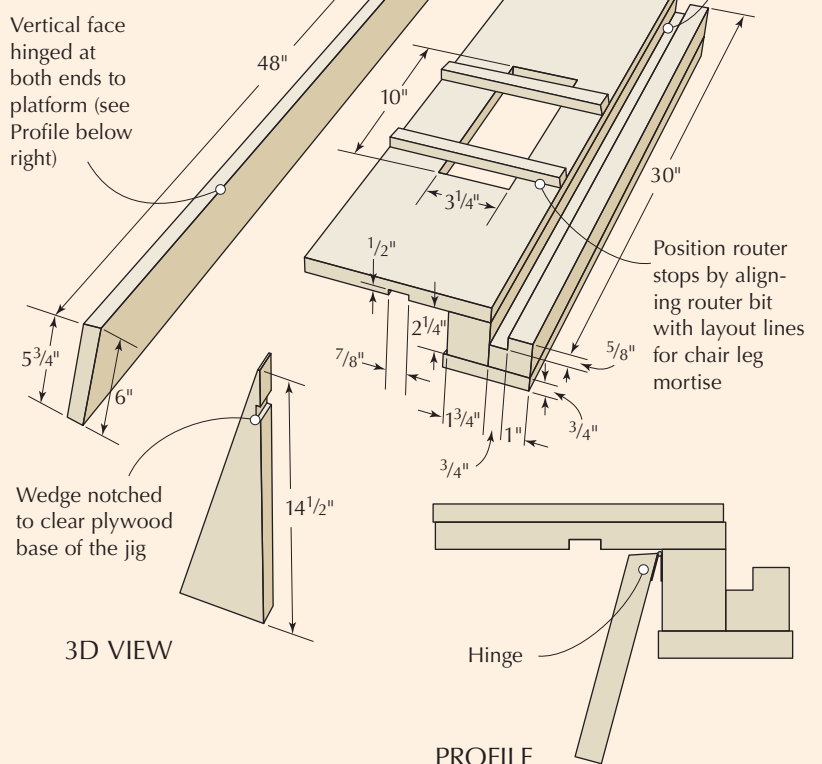
SHOP-MADE MORTISING JIG

If you don't have a good method for cutting the angled mortises, or, for that matter, straight mortises, this jig is not a lot of trouble to build, and can do both types of mortise and cut the flat for the side rail on the rear legs as well.

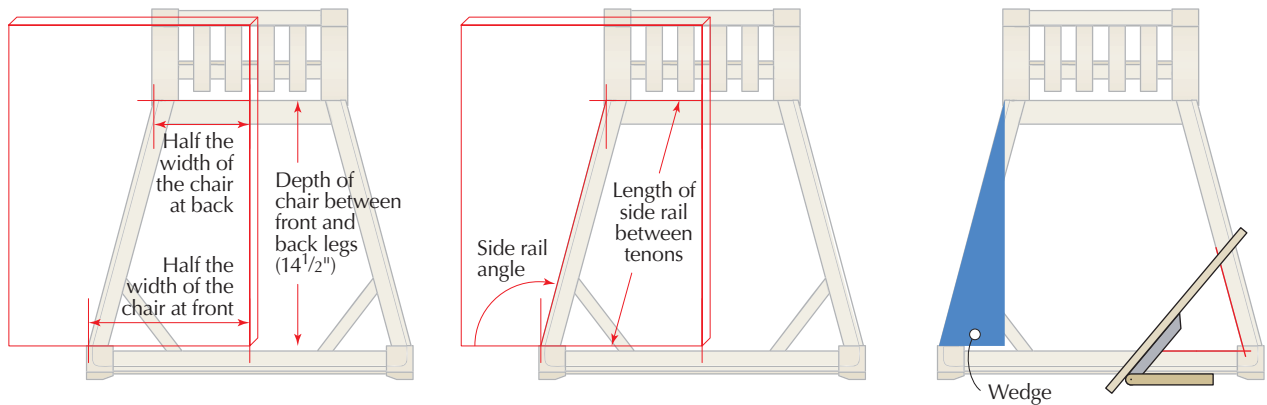
The jig allows you to hold the work in position on the vertical face while you rout. The router fence works with the track on the jig to limit the router's motion to back and forth, and the stops on the top of the jig are set to limit where and how far the router travels back and forth.

The vertical face is hinged to allow for the angled mortises we need on this chair. You can screw a wedge with the angle determined through your full-scale drawing behind the vertical face to directly transfer that angle to the jig.

The top (horizontal) surface of the jig with the large rectangular cut-out allows you to support the router fully as you mortise, but also allows you to cut the flat for the side rail on the back legs. Use the router without the fence for this operation. The underside of this horizontal surface has a dado running along its length. The sole purpose of this is to make room for the leg as you angle the vertical surface of the jig.



DETERMINING THE SIDE RAIL ANGLE & CORNER BLOCK LAYOUT



The angled mortises in the front legs are easy once you've set up for the backs. Simply rout the $\frac{3}{8}$ " angled mortises to roughly $1\frac{3}{16}$ " deep (measured on the shallower side of the mortise). Don't forget that here, as with the back legs, the right and left legs are symmetrical, but require a mirror-image set up.

Once you've cut the mortises, you can move on to tapering the front legs. What I do here is not at all standard.

Taper the two front-facing sides of the legs first, down to 1" at the bottom. This looks better to my eye than the usual taper on the inside (rear-facing) sides. The two sides of the front legs that face each other get a taper that starts about $3\frac{1}{4}$ " down from the top of the leg, and once again tapers down to 1" at the bottom. Leave the flat area around the mortise untouched.

Side Rail Tenons

The side rails start out easily enough. After dimensioning the material (see the cutlist for sizes), cut 2" straight tenons however you usually cut your tenons.

Angling the shoulders gets a little more complicated, though. There are ways to start this process and at least score the shoulders on some machines using a wedge, but this is actually much simpler as handwork. You can simply scribe the angles and cut to your lines. But the easiest way to deal with these shoulders is to use a tenoning frame and chairmaker's saw. (I wrote about how to make this appliance and saw in the February 2014 issue (#209) of *Popular Woodworking Magazine*).

Use the wedge from the mortising jig, or make up one to the side-rail angle you determined with your full-scale drawing, then simply saw your shoulders all the way around the rail. Remove the wood up to the angled shoulders with a handsaw and router plane. Round the ends of the tenons if necessary to fit routed mortises, or leave them square if you've used a hollow-chisel mortiser.

The length of the side rail is as important as the angle, so you need to work through finding this length methodically. Start by cutting the tenons on the backs of the side rails, then cut and fit the angled shoulders. Now measure the length of the angled line you drew to determine the angle of the side rails. Because the layout of this line is based on the distance between the front and back legs on the chair, it should give you an accurate measurement (if you transferred the angle accurately). Measure this distance on the outside face of the side rail, then mark the angled shoulder location.

Before you move on to cutting anything, double-check to be sure that this distance is correct. Dry-assemble the back legs and rails with the side rails, and the front legs and rail. Now hold the front leg assembly up to the shoulder marks on your side rails to see where the rails will intersect the front legs.

There should be a $\frac{1}{16}$ " reveal between the side rails and the front legs. If things don't line up properly, move the front assembly in or out parallel to the back until you find the proper place, then re-mark your angled shoulders.

Add enough length for your tenon and cut the rail to size. Now you can cut a straight tenon on the end sized to fit the leg mortise, and set up to cut the angled shoulders along the marked line.

Cut the beveled ends of the seat-back rail on the table saw, either using a wedge (the same one from the mortising jig) or by angling the blade. Check the fit carefully, then drill pocket holes on the inside face of the rail for attaching to the side rails. There's no need to install this rail now.



Angled shoulders. A "chairmaker's saw" makes quick work of cutting accurate angled shoulders.



Trust, but verify. It's best to double-check your measurements by doing a dry-fit of the back legs and rails, then showing the dry-fit front-leg assembly to the side rails.

This completes the joinery for the chair's frame.

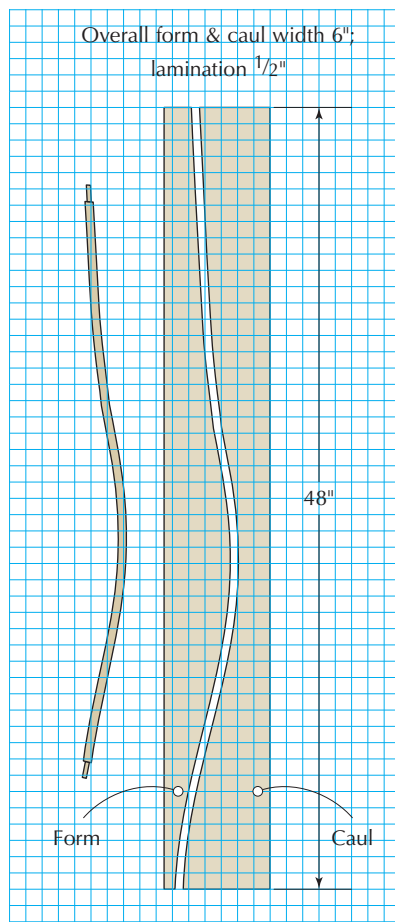
Curve Creation

The slats, which form the chair's back and run almost to the floor, are laminated for strength; cutting them out of solid stock would invariably lead to short-grain sections that would be very fragile. Lamination is the best approach.

Begin by making a lamination form and caul (though you can skip the caul and make a wider form capable of gluing up four or more slats at once if you have a vacuum press). Enlarge the form shape from the Slat Form Pattern (above center) and copy it onto a piece of $\frac{3}{4}$ " plywood or MDF roughly $6\frac{1}{2}$ " x 48" ($4\frac{1}{2}$ " x 48" if you don't need the caul). Cut out the form on the band saw, then smooth carefully to your line. Now trace this curve onto a second layer of plywood, and cut this one out as well. Glue and screw the two layers together, flush-trim the new layer to the smoothed curve, then sand the two smooth.

If you're making a form for a vacuum press, you should repeat this process until your form is at least $5\frac{1}{4}$ " wide (seven layers). If you'll be clamping your laminations, it's time to switch over to making the caul.

You can use the wood left over from



SLAT FORM PATTERN

One square = 1"

cutting the form to make the caul, but you can't just use it as-is. Instead, you'll need to create the caul shape by offsetting $\frac{1}{2}$ " from the form. The easiest way to do this is to use a small disc with a hole in the center exactly $\frac{1}{2}$ " away from the edge of the disc. An adjustable hole saw (also known as a fly cutter) set in the drill press works well to make this disc. Sets of these offset discs are also available for sale (Lee Valley). You can then insert a pencil into the hole in the disc, roll the disc along the curve of the form, and draw the exact shape of the

form. Cut this out, smooth to the line, and duplicate a second layer as you did for the form.

Now mark a reference line across the bottom of the form 5" up from the end. This line will help you locate the lumbar curve in the right place on the chair. Because this reference line does not include the tenon in the lower back rail, you need to be sure to locate your slat laminae at least 1" below the line when you glue up. Wax your form and caul thoroughly, or add a layer of plastic packing tape to the clamping surfaces so you don't glue your slats to the form.

Cut Lamination Strips

Select a flat-sawn $1\frac{1}{4}$ " x 6" x 40" board from which to cut the lamination strips. Rip the board into two pieces of identical width, then mark two distinctly different layout triangles on the faces of these boards.

Now set up your table saw for ripping $\frac{1}{8}$ " strips – but it's not safe to simply set the fence to $\frac{1}{8}$ " and rip; you'll likely experience some nasty kick-back if you try. Instead, set the rip fence to take off $\frac{1}{8}$ " to the outside of the blade. You'll get cleaner results and be safer if you set a featherboard just ahead of the blade to help hold the stock against the fence. Don't let the featherboard press the strip against the blade or it will cause trouble.

Rip both your boards at the same setting, pushing the boards through with a push stick. Set the strips aside, starting a separate pile for the strips from each board. Then reset the fence. Add $\frac{1}{8}$ " (the desired thickness of the strips) to the exact thickness of the blade to determine how much to move the blade each time.

Rip the next pair of strips, add the strips to the appropriate pile, and re-



Thin rips. To safely cut these $\frac{1}{8}$ " lamination strips, cut to the outside of the blade and use a featherboard to help hold the stock in place just before it contacts the blade.

peat until you've got the 16 strips you need. Do not attempt to rip strips out of a board narrower than $\frac{1}{2}$ ".

Slat Glue-up

I use plastic resin glue when I have laminations of this sort to do. The glue forms a very hard and rigid bond that allows for little, if any, spring-back. Mix up the glue according to the directions, and spread it on three of the strips using a foam paint roller.

Stack the three glued strips, add the fourth strip, then place the slat in the form (see images at right).

Leave the lamination clamped up for at least 12 hours, maintaining a temperature of at least 70° F. (I use a cheap electric blanket to keep the glue-up warm in the winter.) Then remove the slat and repeat. In a vacuum press on a wider form, you should be able to glue up all four slats at once.

The only decent way to clean up these slats is to run the edge over your jointer (exercise great care; the slat is narrow) and then through your planer. The glue will not be kind to your knives. Clean up the slats to $\frac{15}{16}$ " wide. Then plane, scrape or sand every face.

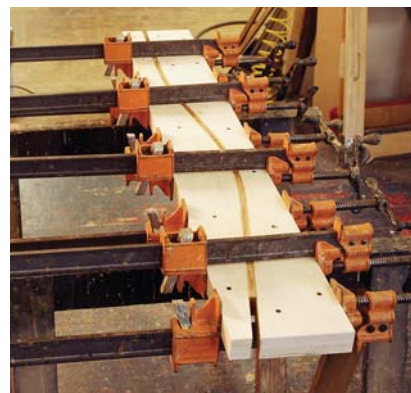
Slat Mortises

It is stronger (and a little easier) to mortise the rails for the whole slat than it is to cut tenons on the ends of the slats, then cut smaller mortises. You'll have to be careful, though, to avoid leaving gaps around the slats where they go into the rails. It helps if you can cut the mortises slightly undersized, then plane the slats to fit.

Lay out the mortise locations centered in the width of both the top and bottom rails, then cut them. If you rout the mortises, you'll need to carefully pare the corners square. (If you use a



Roll away. I find it easy and efficient to apply glue with a roller three strips at once before placing the fourth strip of each back slat atop the sandwich. Stack up the three glued strips and add the fourth strip of the set. Place the bundle between the form and caul and clamp up, spacing your clamps about every 6" and placing clamps alternately on the top and bottom.



Pressed into shape. The bending form and caul capture the laminations as the glue dries. Place clamps alternating top and bottom every 6", then let the glue dry for at least 12 hours.



Sucked into shape. If you have a vacuum press, make an at-least 5 $\frac{1}{4}$ "-wide form and you can glue up all four laminated slats at once.

hollow-chisel mortiser, you may also need to pare the edges clean.)

The curve of the slats should be roughly aligned with the curve of the rear legs. The 5" mark on the bending form should help you to position them correctly. Be sure to add whatever length you need for the insertion of the slats into the lower rail mortises.

You'll need to insert the lower back and crest rails into one of the legs to determine the overall length for the slats. They should fit to the bottom of the mortises. Be sure that each of the slats is cut in the same way so the shapes match when installed; it can be confusing because the curve is not quite symmetrical.

Fit each slat to its mortise, and mark each for location as soon as each is ready.

Dry-assemble the chair to ensure everything fits, and make adjustments as necessary. Mark where the side rail tenons come through the back legs and cut off the excess, leaving $\frac{1}{16}$ " to $\frac{1}{8}$ "

beyond the marks. You'll flush this off after you glue up the chair.

Before you can glue up the chair, you need to rabbet the tops of the front and side rails for the seat blank. The front rail is easy, and can be done on the table saw. But you'll need to avoid cutting into the tenons on the back of the side rails. Use a router table for this, or make stopped cuts on the table saw, then follow up with handwork to clean up the uncut parts of the rabbets.

Finally, cut kerfs in the ends of the rear side-rail tenons for the wedges, and make up a bunch of wedges.

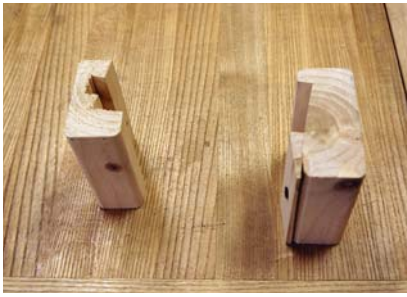
Chair Assembly

Complicated glue-ups are no fun at all – and this chair is pretty complicated. So gluing up in stages makes sense. Working on manageable subassemblies takes most of the stress out of the process, as well as many of the clamps.

The angled mortises make it very difficult to fit the side rails into place if the front and back are already to-

"When tools were rude, great precision and nicety of finish could not be expected. To return to the crude joints of our ancestors would be a distinctly retrograde move."

—David Denning,
from "The Arts & Craft of
Cabinetmaking" (1891)



Glue-up help. Make a set of cauls to cradle the leg-to-side-rail subassemblies. They'll allow you to place the clamps without marring the wood.

gether. It is possible, but it will be nerve-racking (don't ask me how I know this). It makes much more sense to glue the front and back legs to each of the side rails first. You'll need to make up a set of cauls to clamp this subassembly together effectively and without marring the legs.

You'll also want to get your wedges for the tenons, and have a small hammer ready.

Spread enough glue in the mortises to wet the side walls, but not so much that the glue drips and pools at the bottom of the mortise. Then, spread glue very lightly on the tenons (it should look like you wiped off the glue you applied) and insert them into the mortises. Put your cauls in place and clamp up tight.

Wait a minute for the glue to tack up, and then remove the clamps and clamp the rail in a vise. Spread some glue on your wedges and carefully tap them in until they are fully seated.

Then put your cauls and clamps back on and let the side assembly sit until the glue is set.

The back rails and slats are next. This time, spread glue very lightly just in the mortises; don't put glue on the ends of the slats. You don't want glue squeezing out all over the place, and in any event, these joints are completely captured. If the slats don't seat all the way, you can clamp from the top to the bottom rail to pull things tight.

Make an angled caul for the lower back rail. You'll also need to clamp a block across the top of the slats and another block below the clamps that spans them to prevent clamp pressure



Listen carefully. The sound of your tapping will change to a duller tone when you've got the wedges in all the way.

from simply bending the slats, as shown in the picture below at bottom. (Once the slats are fully seated, you should no longer need any of these clamps.)

Check the fit of the backslat and rail assembly in the back legs. If your slat lengths were off a little bit, you'll find that the tenons on the rails no longer line up with the mortises in the legs. You can take just a little bit off the tenons on the rails to compensate.

The final assembly requires only three clamps: one for the clamping the front legs to the front rail, and one each across the back legs at the crest rail and lower back rail. Spread glue in the



Reclamp. With the wedges seated, put the sub assembly back in clamps and wait for the glue to dry.



Clamp the back. Note the angled caul for the lower back rail, as well as the two cauls at the apex of the bend. The clamps there keep the slats in proper alignment.

mortises and lightly on the tenons, put the chair together and clamp. Leave the chair in clamps to dry fully.

Finishing Touches

It seems like you're about done at this point, though there are plenty of little details that still need to be taken care of. But it's worth taking a moment to savor what's happened thus far. You might even want to find a scrap of plywood big enough to use as a temporary seat and try out your chair. But then it's back to work.

Once the clamps are all off, you'll need to deal with the through-tenons of the side rails. Saw off the wedges, but keep clear of the leg surface. You can clean the tenon up further with a combination of spokeshave, scraper and sandpaper.

Next up is cutting away the inside of the tops of the front legs to complete the recess for the slip seat. Rout away the bulk of the wood using a trim router with a 1/4" straight bit, and finish up with chisels and a gouge for the curved corner. If you're building a set of chairs, you might want to make a pattern, clamp it in place and use that



Almost there. With the subassemblies dry, the chair can be clamped together.



Careful now. Avoid marring the leg surface as you flush the wedges.

to guide your router so the seat recesses all match.

Screw the seat-back rail into place.

The front of the chair needs corner blocks. To determine their exact angle, extend the lines of the inside edges of the rails until they intersect, as shown in the third illustration on page 30. Then measure with a ruler or a set of dividers about 6" out along both of the rails. Hold a straightedge up to these marks, then set this angle on a bevel gauge. Set your table saw blade to this angle, and cut your corner blocks using a miter gauge. A fence that extends across the blade will help make this a safer cut.

Then drill countersunk pilot holes for four screws that will attach each corner block to the rails. Drill a $\frac{3}{16}$ " hole through from the top to the bottom edge, which you'll use for bolting the seat onto the chair. Counterbore this hole from the bottom of the corner block with a $\frac{1}{2}$ " drill for the washer and bolt head. (I usually don't attach the corner blocks until after applying finish to the chair; it's just easier to finish when they're not in the way.)

The slip seat is a piece of $\frac{3}{8}$ " plywood (don't use MDF here). Cut the front-to-back dimension first. You want to leave roughly $\frac{3}{32}$ " of space (this will vary based on the thickness of your upholstery fabric) between the seat blank and the lip of the seat rails and back legs.

Clamp the still-oversized blank to



Seat recess. A trim router with a $\frac{1}{4}$ " straight bit makes quick work of the bulk of seat recess waste atop the legs.

the top of the chair, and trace around the outside of the side rails. Then offset this line in the thickness of the lip on the side rail plus $\frac{3}{32}$ ". Cut to this line, then check the fit of the seat blank in the chair. Adjust the curve at the front corners to leave an even gap there as



On the level. If your legs are close to level, simply rub the longest one over rough sandpaper to adjust it to perfection.

well. Once you've made one seat blank, you should just be able to duplicate it for the rest of a set.

Once again, place the seat blank in position and clamp in place. Drill up through the holes in the front corner blocks. Remove the seat blank and pound #8-32 T-nuts into the top holes on the top of the seat.

Set the chair frame on a flat surface—I use the table saw—and check to see if the legs sit flat on the table. If you've got just a little bit of correcting to do, take a sheet of heavy-duty sandpaper and place it under one of the longer legs. Hold the leg with one hand and pull the sandpaper out from under the leg with the other. Check the results and repeat as necessary.

If things are really off, you should shim the chair level then scribe around the legs using a small spacer block and a knife. Then cut the legs off to your lines.

Chamfer the bottom corners of the legs, then hammer in some glides. The glides will protect both the bottom of the legs and your floor from damage.

If you're comfortable upholstering the seat yourself, go for it. I prefer to leave that to an expert, and simply bring my chair, seat blank and fabric to a local upholsterer and ask for a thin layer of dense foam, another layer of softer foam, and a layer of cotton batting over the top.

Now it's time to have seat and enjoy your comfortable and stylish new chair. **PWM**

Jeff builds furniture and teaches woodworking from his shop in Chicago.

ONLINE EXTRAS

For links to all online extras, go to:

■ popularwoodworking.com/oct15

BLOG: Visit Jeff Miller's blog and web site.

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Drawer Slips

BY GEREY COY

An historical detail adds refinement to projects both period and modern.

The 18th century – a time when human hands were set to work in order to create the objects of material culture; when men and women by their sweat and ingenuity wrought wares in the latest fashions; when the cabinetmaker, toiling away in dusty corners of the world, rode at the vanguard of improvement and progress.

Over the course of that century, anonymous workers of wood trained their planes and chisels on many problems, perhaps none so unassumingly complex as that of making drawers. Their search for elegant and durable methods of affixing bottoms, in particular, led them to one of the final developments in the art of crafting fine drawers by hand: slips.

Drawer slips – slender pieces of wood glued to the sides of a drawer and grooved to accept the bottom – have remained largely mysterious, especially to those of us on American shores. But the time has come for the light of history to shine once again on these milestones of human thought and hallmarks of careful craftsmanship.

In the Beginning

The earliest drawer bottoms were little more than boards nailed to the underside of boxes. This arrangement was perfectly satisfactory, as drawers did not ride upon their bottoms. Instead, grooves plowed into their thick sides engaged with guides attached to the surrounding case.

As time passed, new types of lumber were made available, novel forms of furniture emerged, and fashion began to dictate slimmer drawer components.

English cabinetmakers abandoned the exterior groove, instead designing cases in which drawers rode directly on their bottoms. But the bottoms wore and nails loosened, compromising the integrity of both drawer and case. Something needed to be done.

In particular, the drawer bottom needed to be raised. The most straightforward solution was to affix slender pieces of wood underneath the bottom and sides. These runners, sometimes referred to as “slips” (though of a different sort than the subject of this article), were usually applied with glue

and could be easily replaced. The whole arrangement appeared awkward, however, and was sufficiently unsound that further experiments were warranted.

A breakthrough came in the 1720s. Rabbits were cut into the lower, interior edges of the sides and front, allowing both the drawer bottom and runner to be tucked neatly within the confines of the drawer. It was a remarkable achievement in construction. The bottom and runners were stabilized within the rabbets, the runners were still easily replaceable, and, with a nod to appearance, the entire assembly was now hidden from view.

One weakness remained, however: the bottom was fixed in place, unable to shrink and swell with the seasons. Though rabbets-and-runners remained the dominant form of attaching drawer bottoms through decades worth of cyclical expansion and contraction, the inevitable splitting of bottom boards called for more ingenious ways forward.

Slips Onto the Scene

References to slips began to appear in print by 1788, when the first edition of the “Cabinet-makers London Book of Prices” included a succinct entry for “slipping drawers.” Later editions of the same work (1793 and 1803) offered more detail in proposing prices for “slipping drawer sides and plowing in bottoms.”

A definitive description of drawer slips was not published until 1803, when the following appeared in Thomas Sheraton’s “The Cabinet Dictionary:”

“Slips are sometimes glued on the inside of drawers, and plained [sic] to receive the bottom, which is the best method for preventing drawer bottoms from splitting, as is too often the case when they are confined by a rabbet, and the slip is glued down at the under side.”

Ten years later, Thomas Martin cribbed Sheraton’s definition for his “Circle of the Mechanical Arts,” an appropriation repeated by Peter Nicholson in his “Practical Carpentry, Joinery,

Plow slips, not drawers. Grooves to accept a drawer bottom are plowed into the edge of a wide board, which will then be cut into narrow slips.



and Cabinet-making” of 1826. Nicholson, at least, elaborated on the reasoning behind the use of slips:

“Drawers made of unseasoned wood, break at the joints: to prevent this, slips are sometimes glued on the inside of drawer-sides or ends, and these are grooved to receive the bottom, and the upper edge rounded; this is esteemed the best method for preventing drawer-bottoms from splitting...”

It is notable that these early chroniclers mention only that slips were employed to avoid split bottoms. This may have been the real problem that spurred period makers to action. Sensing that drawer bottoms would be able to more freely expand and contract in a groove than in a rabbet, they discovered a clever way to retain the best features of earlier systems—an elevated bottom and wide bearing surfaces—while leaving the bottom free to move, even in the thinnest of drawer sides.

This discovery almost assuredly took place in England, where a preference for slipped drawers in bespoke work persists to this day. The English taste for thin drawers never made its way across the Atlantic, where thick sides in softer woods have long been more common. Because slips were likely developed at a time when England’s influence in this country was waning, using rabbets-and-runners and plowing grooves directly into thick sides remained the standard methods of attaching bottoms for American cabinetmakers.

Make Your Own

In examining how slips are made, it’s natural to begin with the rounded version, generally regarded as the earliest form.

First, prepare the front, back and sides of a drawer in the usual manner. Lay out the dovetails in front, keeping in mind that despite using slips along the sides, the drawer front must still receive a $\frac{1}{4}$ " x $\frac{1}{4}$ " groove to support the bottom. Therefore, plan to cover the groove with a full or half tail.

With the drawer box assembled, prepare a board from which to cut the slips. It should be longer than the drawer sides and wide enough to produce several slips (which also makes it easy to hold in a vise). Its thickness should be equal to the height of the slips, plus an extra $\frac{1}{64}$ " or so for trimming. In practice, the position of the groove in the drawer front determines the finished height of the slips, because each slip must bear a corresponding groove in its inner face. Also, enough wood must remain to support the bottom; $\frac{3}{16}$ " above and below the groove is a good compromise between strength and appearance.

Secure the board, square the upper edge and plow a $\frac{3}{16}$ "-deep groove a hair more than $\frac{3}{16}$ " from the reference face. This slight addition will allow the slip to project from the drawer side so that it may be planed perfectly flush after gluing.

Plane the upper, interior edge of the future slip into a series of long facets,

“Don’t fear slow, only fear stop.”
—Chinese saying



A slip is born. After its groove is plowed and top edge shaped, each slip is marked for width and sawed free.

blending them with light passes to arrive at a final rounded shape. Referencing from the grooved edge, scribe the width of the slip on both faces of the board. Saw just outside the line, and plane the resulting slip down to its finished width.

Prepare the slip to meet the drawer front and back. First, cut a small tenon at the front end. Mark a shoulder line $\frac{1}{4}$ " from the end, and saw away the material above and below the groove. The resulting tenon is a positive version of



Clean-up work. The back of each slip is planed to remove saw marks and to square up its gluing surface.



Two slips, two tenons. Small tenons are formed on the front ends of a round slip (left) and a flush slip (right).



Perfect mate. The round slip's small tenon fits into a groove in the drawer front, making alignment during glue up a cinch.

the groove's negative space and should register neatly with the drawer front.

Next, form a notch at the top rear of the slip. Its depth is equal to the amount of material above the groove, which allows the top of the groove and the bottom of the drawer back to align.



Notch in rear. Round slips are notched to pass under the drawer back and to align their grooves with the back's bottom edge.

Butt the shoulder of the slip's tenon against the back of the drawer front and scribe where the rear of the slip meets the inside and outside of the drawer back. Transfer the latter mark around the entire slip, and cut and plane it to length. Use the inside mark to square across the top of the slip, then transfer it down both vertical faces to the top of the groove. Saw and pare away the waste above the groove.

All that remains is to glue the slips in place, clamping to ensure solid contact along their entire length.

Modern Styling

Flush slips are so named because the top surface of the drawer bottom sits flush with the top surface of the slips – a look that appeals to more modern sensibilities. In order to achieve this, the sides of the drawer bottom must be rabbeted along their top edges, and the lower, front edge of the bottom rabbeted to fit a groove plowed higher up the drawer front.

After plowing a $\frac{3}{16}$ "-wide x $\frac{1}{4}$ "-deep groove in each slip, cut a tenon on one end. This time, square across the bot-

Make it proud. Affixing a slip to protrude slightly below the drawer side allows you to plane it perfectly flush after gluing.





Layered grooves. The groove in the drawer front accepts a flush slip's tenon and eventually, the rabbeted front edge of the drawer bottom. The bottom's rabbeted sides slide into grooves in the slip.



No measuring. With the slip firmly seated against the drawer front, mark its finished length directly from the back of the drawer.

Offset rabbets. Flush slips require a specially shaped bottom; it is first rabbeted along the top of one side, flipped over, then rabbeted again along the front edge.



Rabbets, meet slips. To ensure a clean fit, the shoulder of the first side rabbet is pressed against a slip while the second rabbet's shoulder is scribed directly from the other slip.



Sliding home. Flush slips support a drawer bottom along its sides, while a groove in the drawer front receives the bottom's rabbeted front edge.



Behind the scenes. A view of the back of a drawer reveals the profile of a flush slip and a rabbeted bottom.

tom face of the slip $\frac{1}{4}$ " from the front end, and transfer the mark up the vertical faces to the top of the groove. Saw out this lower portion, then repeat for the other slip.

Because flush slips simply butt against the underside of the drawer back, they don't require a notch at rear.

Seat the tenons into the groove in the drawer front, mark and cut the slips to length, and glue them to the drawer sides.

Now make the rabbeted drawer bottom. First, cut a rabbet into the top of one side. The rabbet's depth should be the distance from the top of the slip to the top of the slip's groove and its width identical to the depth of the grooves. Next, cut a rabbet into the lower front edge of the drawer bottom. Its width is again equal to the depth of the grooves, but this time its depth should be the distance from the bottom of the slips' grooves to the bottom of the groove in the drawer front.

Set the drawer box on top of the partially rabbeted bottom, pressing the shoulder of the side rabbet against its corresponding slip. Scribe a line where the bottom meets the other slip; this establishes the edge of the second side's rabbet. Cut the rabbet into the top edge of the second side to the appropriate depth.

The bottom should now slide in from the rear, its top surface butting against the bottom edge of the drawer back, its sides engaging with the grooved slips and its leading edge ultimately entering the groove in the drawer front.

Face first. To simplify the fitting of mitered slips, glue the front slip in place before mitering and notching the side ones.



Get in the grooves. A small scrap of wood planed to perfectly fit the grooves of mitered slips guarantees that they'll be aligned after glue up.

Another Angle

Mitered slips are perhaps the easiest version to make. Because they do not require a groove in the drawer front, they involve much less initial planning and make laying out symmetrical dovetails a straightforward affair.

Start by preparing a grooved slip for the front of the drawer. Miter both ends to fit snugly between the drawer sides, profile the top edge to your liking, and glue the slip in place. Next, miter one end of each side slip, press it against the corresponding miter at the front, and mark for length and notching. As in their rounded brethren, the top of the groove in mitered slips should align with the bottom of the drawer back. Cut the notches accordingly, profile the top

edges to match the front slip, and glue the side slips to the drawer.

Worth the Effort

Slips do require a bit of extra effort, but as symbols of attentive and thoughtful work, they imbue meaning even to parts normally hidden from view. They evoke, too, the spirit of cabinet-makers past who, through decades of experimentation, wrestled with the intangible forces of weight and wear and the seasonal expansion of wood to produce a tradition of small boxes capable of great endurance and subtle beauty.

Given the vast scale of industry and manufacture governing our era, it is now rare for those devoted to the



Mitered underbelly. A drawer front, drawer side and two mitered slips combine to form a seemingly complex joint.

intimacy of craft to effect such widely influential change. But for those of us engaged in making fine things out of wood, quiet moments of pride at having done the simple things well and beautifully—slipping drawer bottoms, for instance—often prove satisfaction enough. **PWM**

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ONLINE EXTRAS

For links to all online extras, go to:

■ popularwoodworking.com/oct15

WEB SITE: Visit the author's web site for a look at his work and photography.

ARTICLE: Read "Four Good Ways to Make Drawers," if slips aren't your style.

IN OUR STORE: Get the June 2015 issue for step-by-step instruction from Jeremy Coy on building a "Sideboard fit for Tea."

TO BUY: "Building a Classic Drawer with Alan Turner," available on DVD or as a download.

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Beauty & brawn. Whether round (left), flush (middle), or mitered (right), slips provide plenty of wearing surface to thin drawer sides while supporting bottoms in expansion-friendly grooves.



Tool Chest as Art

BY JAMEEL ABRAHAM

An embellished lid is your
woodworking calling card.

Embellished tool chests are perhaps the quintessential calling card of the cabinetmaker. From Benjamin Seaton's mahogany and tulipwood masterpiece to the unequalled work of Henry Studley, we woodworkers tend to pull out all the stops when we decorate our chests.

I'm convinced that the old timers built as much for their own eyes as their customers'. And because I don't build furniture for a living, I designed this chest lid for me, with its inlaid dividers, dovetail saw and crossed chisels. A sort



High-class ply. Like a good sandwich, the best plywood is homemade. Make sure you alternate each layer at 90°.

of coat of arms for the battle against cheap furniture. With that in mind I ask you, “are you ready for a war?”

The Foundation

Typical chest lids are constructed either of a solid panel framed by a narrow dust seal, or by a smaller panel or two and wider, more substantial frame members to help keep the lid flat and isolate wood movement. I wanted as much real estate as possible for my embellishments, so a solid lid with a narrow dust seal would be ideal.

To get the stability needed, there is only one option for quality work: lumber-core plywood. This product has all but vanished from lumberyards, so I made my own with the best materials.

Lumber core has the same basic structure as any plywood: an odd number of layers with grain running perpendicular in each layer. But the core is thicker in a lumber-core panel, so you can work it and attach hardware to it like a solid-wood panel.

For the core I used mahogany, which I glued up from three boards, each about 6" wide. It's pretty easy to get quartered mahogany in these widths, but any quartered, mild-grain wood will work.

Onto each face of this core, glue a layer of 1/16"-thick veneer or two alternating layers of typical thinner veneer (always glue both sides of the panel at once), orienting the grain at 90° to the layer it's glued to.

I made the panel about 3/4" larger in length and width than the final size. Final thickness is not so critical. My completed lid finished out around 7/8".

The Sunburst

To lay out the sunburst, draw a circle in the middle of the lid, then, using dividers, walk off as many rays as you'd like. Next, strike lines through the center point of the circle to the edge of the lid. Mine has 56 rays. That sounds like a lot, but once they get to the edge of the panel, they end up quite wide.

I didn't want the rays to jump out too much, so I used woods that were close

in value: bird's-eye maple and quartered beech. I resawed these from one board so the grain matched.

Slice each ray at just over 1/16" thick. Cut more material than you think you'll need, then cut some more. You will ruin some.

To cut the rays to shape, first shoot one edge straight and square. My shooting board is ramped to use more of the plane's iron. The board runs uphill so the action of the plane forces the thin ray down onto the board, which is also faced with self-adhesive sandpaper to keep the rays from slipping. A stop at the end keeps the rays from shifting forward. To use the shooting board, extend the edge of the ray over the ramp and plane the edge. The plane's sole doesn't ride against the edge of the ramp.

Now lay out the ray's shape using the lines on the lid, cut close to the line and to length, then plane the tapered edge precisely on the shooting board. Secure the first ray on the lid with push pins, then move onto the next ray, tapping each to its mate as you progress.

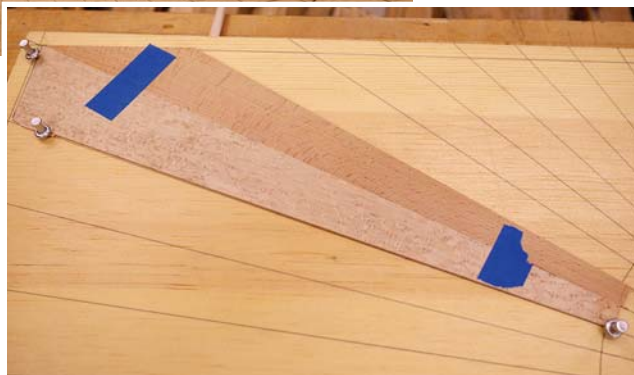
Fitting the rays one edge at a time



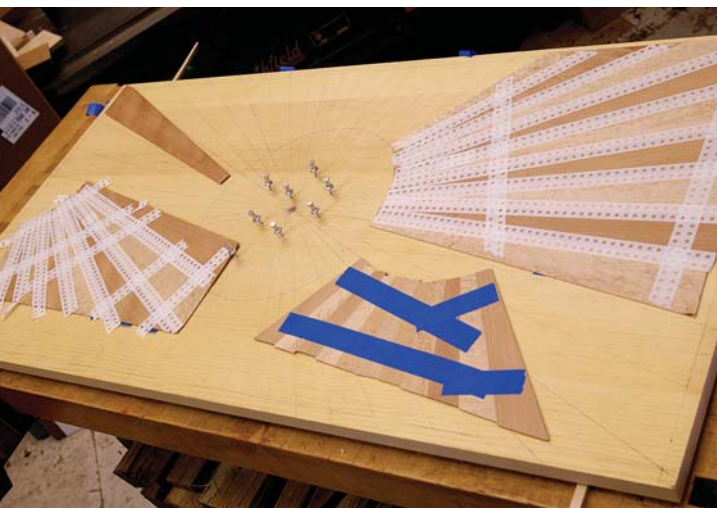
Divide & conquer. One tool is all it takes to lay out the sunburst.



Arrow-straight. A ramped shooting board is used to present the edge of the rays to more of the plane's iron. This keeps your plane sharper longer by spreading the wear on the blade.



One by one. Fit the rays' edges precisely, but keep the narrow end long. The wide end gets trimmed later when installing the crossbanding.



Sectioned off. Assemble a few rays at a time, then assemble each section into the final sunburst. This helps keep you sane.



Here comes the fun. And it's all right. Smooth-planing the sunburst is the first really satisfying moment of the process.

allows a bit of wiggle room. If you're off a tad on one ray, make up for it on the next one. When you get to the last ray, fit each edge precisely, but leave the ray extra long and separate from the others.

The rays are edge-glued before gluing them to the panel. Number the rays in sequence and, using a pencil, draw a light line that crosses each ray all around the sunburst. This will help you align each section during assembly.

Separate the sunburst into sections of about eight rays. Flip over each section and tape the rays together. Now flip it back over and remove the small pieces of tape you used to join each ray. Replace these with veneer tape along each joint. Once the veneer tape is dry, flip the section over again and remove the masking tape.

To glue each section, fold open the rays one by one to expose the joint, run a small bead of glue, then do the next joint. Clean any squeeze-out, then lay the section flat between a couple of pieces of MDF or plywood and put a weight on it. Line the MDF with packing tape or waxed paper so the glue doesn't stick.

With all the rays glued and cured, glue each section together the same way. Check the fit of all them together before gluing. You can tweak the fit by shooting the edges of the sections.

Finally, the last oversized ray is fit. It will need to be refit because the glue thickness, multiplied over 56 joints, has slightly changed the shape of the

sunburst. Once fit, glue both edges and tape it into position. Don't force it in too tight, or you'll cause the whole sunburst to buckle like a potato chip. After it cures, scrape off any dried glue, then glue it to the plywood panel, along with the outside veneer (mine is sugar pine). After the glue cures, smooth-plane the sunburst.

Crossbanding & Medallion

To make the Macassar ebony crossbanding, cut slices from the end of a board about $\frac{5}{8}$ " thick, then sandwich these between double layers of holly and black-dyed veneer. Make sure the blank is longer than the longest run of banding on the lid. Glue them together in a "press box" made from plywood. I line the inside of the press with packing tape so the glue doesn't stick. Because the ebony glue surface is all end grain, use epoxy. When the glue is cured, saw strips from the edge of the blank just a bit thicker than the sunburst.

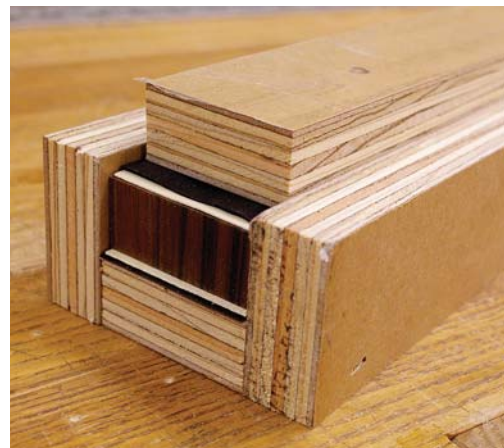
To fit the banding, cut a shallow rabbet around the entire perimeter. Use a router with an edge guide to get close to your layout lines, then use a shoulder plane to make it all as perfect as possible. Where the banding wraps around the corner squares, hinges and catch, do the layout with a square and marking knife, then rout and chisel to the gauge line.

Start at any corner and cut a miter on one end of a piece of banding, then

mark the other end and cut the miter, then glue it in place with masking tape wrapped over the edge. Fit the next piece to the end of the first piece, miter the opposite end, and glue. This way you're only fitting and gluing one side of a miter at a time. Only the very last piece requires fitting both miters before gluing.

I use a small miter box with a fine dozuki saw and a small plane to tweak the angle. A small piece of scrap plywood with sandpaper glued to both faces acts as a planing support. You'll need to plane from both directions in some cases to prevent blowout of the stringing or short grain.

Crossbanding is unusual in that the grain runs opposite to a typical miter.



Squeeze this. The press box ensures your banding blank glues up straight and flat. I make these quickly with a pneumatic nailer.

It's tricky. Don't be discouraged if you toast some of the banding. I did. For every goof, you've gained twice the experience.



This means you can't always plane with the grain. So use a file or sanding block to tweak the miter.

The bookmatched kingwood corner squares and holly stringing are fit and glued next. The crossbanding and corners should be oversized, so when you trim the lid to final size, they will terminate crisply at the very edge. I added a $\frac{3}{16}$ " strip of cherry banding to the short ends of the lid, which will get buried in the lid's skirt.

The circular crossbanding is easier than you might imagine. First, set up a router for circle cutting and rout a groove around the center of the sunburst.

Now crosscut tiles about $\frac{5}{8}$ " long from a $\frac{1}{8}$ "-thick, $\frac{3}{4}$ "-wide Macassar ebony strip. Plane both long-grain edges of the tile to a taper (you'll get the angle right with some practice). Glue it down with hide glue as you press it to the outside edge of the groove. Move from tile to tile, fitting each one individually while gluing it to the edge of the previous tile. Don't worry about the gap at the outer diameter—but don't let it get too large.

After the glue cures, plane the tiles flush with the sunburst. Set up a small router to cut the channel for the stringing between the outside edge of the tiles and the sunburst. I use a $\frac{3}{32}$ " end mill in a Dremel tool with a mini router base.

To glue in the stringing, first glue the veneer lines together for the first inch or

so for easy handling, then take a chisel and cut a miter on this end. With a little glue in the groove, begin pressing the stringing into the groove, doing a few inches at a time. They should be snug, but not tight, or they may not fit at all once saturated with glue.

When you reach the beginning, hold the end of the stringing lines up to the miter and cut a matching miter on the free end. If you're careful, this mini



Channel groove. A $\frac{3}{32}$ " metal-cutting end mill cuts a clean path for the stringing.



Rout the enemy. Waste away the center of the circle. The extended base keeps the router from taking a dip.

scarf joint will disappear. Let the glue cure, then plane the stringing flush.

Finally, cut the inside diameter of the tiles with your circle-cutting router then excavate the circle to a uniform depth. You'll need to attach a larger auxiliary base to your router to span the cavity. The final depth should be about $\frac{1}{16}$ " deeper than your medallion's thickness.

With your circle-cutting router, cut a piece of MDF or hardboard to act as a template for sizing the medallion. Fit the medallion template to the lid precisely, but not tightly. If you test-fit the medallion later and it's too tight, it might get stuck. It should fit easily, but not sloppily.

Make the sunburst medallion the same way as the large one. Bookmatch every other ray, number them and arrange them in order as shown below. By arranging the pieces this way, the grain will match all the way around.

Glue it up the same way as before, but this time assemble each half, then



String theory. The block at the top holds the free end of the stringing while you glue a few inches at a time.



It's good to be the king. Kingwood, that is. Arrange the sequential slices as pictured, and each ray will be no more than two slices away from its mate.

joint the two straight edges to complete the medallion. Attach the circle template to the medallion with double-sided tape and rout with a bearing-guided bit.

The Monograms

To make the monograms, start with the background wood. I used kingwood to match the medallion and corner squares. Using resawn stock allows you to make a four-way bookmatch that looks elegant behind the holly letters. Wrap the background with a smaller version of the ebony banding, mitering the corners. At the top and bottom of each monogram, using 30° and 60° miter cuts, create a “weaved ribbon” design. This adds tons of visual interest and dimension to the monogram. Glue each piece to the background’s edge as you fit each miter.

But before the crossbanding can be fit to the background, the holly letters must be inlaid. Well, that’s not entirely true. The letters and mortises are actually cut out simultaneously on the scrollsaw with the table tilted slightly.

This double-bevel technique (about

“It is the first of all problems for a man to find out what kind of work he is to do in this universe.”

—Thomas Carlyle (1795-1881),
“Address at Edinburgh”

which I wrote in the August 2013 issue of this magazine, #205) creates a wedge-shaped holly letter that drops into an equally tapered recess for a flawless fit.

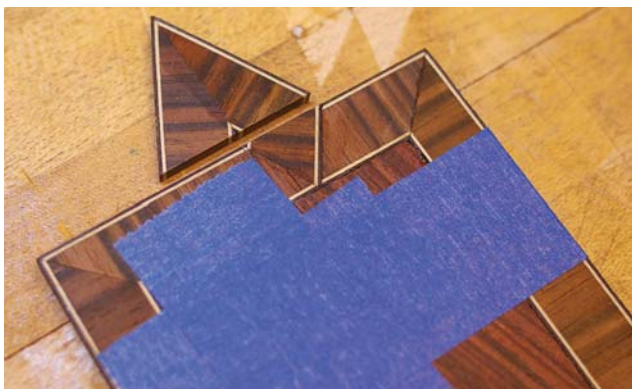
Tack-glue a piece of holly to the kingwood (they should both be the same thickness), tilt your saw to about 10° to start, then make some test cuts on the edge of the piece. If the piece on top fits perfectly in the bottom and ends up flush, you’ve got it. If it’s too loose or tight, adjust the tilt of the table until it’s just right.

When you test-cut, notice that when moving clockwise or counterclockwise, either the top piece will fit in the bottom layer or vice versa. You’ll need this knowledge when cutting out interior shapes, such as the triangle in the letter A. The Roman numerals are made the same way.

Buy a vowel. When you cut the double-bevel inlay, the letters will fit just perfectly. This is inlay for the lazy, but smart.



Here’s the point. Make the points as an assembly, plane the bottom edge flat, then glue it to the top of the monogram. This is much easier than fitting each point separately.



Crisp. If this mortise was cereal, it’d be magically delicious. But you can’t get good results with lucky charms. You need sharp tools, and that’s no blarney.

To inlay the completed monograms, tack them in position with a few tiny dots of cyanoacrylate glue, then scribe around them carefully with a hobby knife.

Pop off the monogram with a thin knife, then rout the mortise to just a little less than the monogram’s thickness and chisel carefully right in the scribe line. Before scribing, you can file the edge of the monogram at a slight angle (just a couple degrees at most), so your scribe line ends up slightly smaller than the inlay, encouraging a perfect fit.

Glue the monograms in using a flat caul, then plane them flush.

At this point, you can scrape the lid flat and smooth, cut the top to final size and apply a finish (leave the outside and edges unfinished for now). Sanding kingwood and holly at the same time is risky business (the kingwood heats up and bleeds red into the holly) so plane and scrape the final surface, sanding very sparingly.

The Montage

Still with me? Excellent. Because the montage is where you get to break free and have some real fun. To get the right look, first make some pencil sketches of your favorite tools. Don’t worry if they don’t look perfect. Just sketch roughly to let your ideas flow. Once I was happy with my sketch, I then refined everything using drawing software so I could easily manipulate the size and arrangement of the tools.

Print the tool profiles and glue them to blanks of boxwood. Cut them out



Pencilshop 2.0.

Use the meat computer God gave you and render yourself a coat of arms.

on the scrollsaw or fret saw and refine their shapes with carving chisels, rasps, scrapers and files. Don't pay attention to which tools overlap the others, or what parts might get cut away. Just carve the tools as if they will stand on their own.

Once the tools are completely shaped, you can begin the layout process. Set out the tools on your sketch and mark the parts that overlap with each other.

Use a marking knife to accurately scribe your cutlines. I use a fine dozuki to make the cuts, then refine them with planes, files and chisels.

Make everything fit sweetly, then tack the tools onto the medallion and scribe with a hobby knife. Press the knife tightly to the edge, make a light pass, then go back once or twice to deepen it slightly.

Pop the tools off the medallion, then rub some chalk dust into the scribe line, which will make it highly visible. Rout the inlay mortise, and chisel right in the scribe line on straight sections.

On tight curves, I use the Dremel tool to rout directly up to the scribe

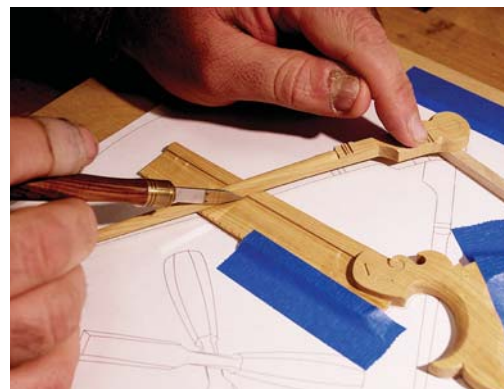
line. When you see the chalk disappear, you've routed to the line.

Ease the bottom arris of the inlay and test-fit carefully. It should be tight. Be careful as you remove the piece; it could chip out some of the short grain if you're ham-handed.

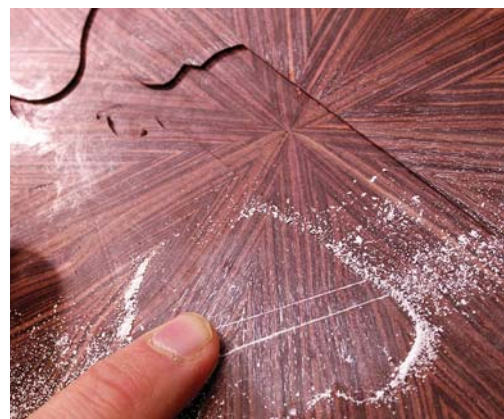
Once the inlay mortises are cut, finish the medallion, keeping finish out of the mortises—I use an old T-shirt on a cork block. Then glue the medallion into the lid.

While that cures, apply finish to the boxwood tools. Mask the bottom surface so it stays free of finish. Once the finish is dry, glue the tools into the medallion using hide glue. Brush a little into the mortise and press the tools firmly in place (tapping lightly with a block and small hammer if necessary), hold for a few seconds, then do the next piece. Don't use excessive glue. When it's dry, you can pop off any little beads of dried glue with the tip of a hobby knife.

If you're thinking of making an embellished lid for your tool chest (and I think you should) make sure you develop a strategy, sharpen your weapons



Slice & dice. With the tools precisely made, you can then cut them up into little pieces. It's a little sad. You have hugged a tree lately, haven't you?



Chalk it up. A bit of white powder in the scribe lines ensures you don't blow it when routing the mortise.

and above all, emerge from the ashes of battle with your own trophy of victory. **PWM**

Jameel is an artist, luthier and co-owner of Benchcrafted (benchcrafted.com).

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Make a 'Raamtang'

BY ZACHARY DILLINGER

This Dutch joiner's tool leverages simple design into a cheap & effective workholding device.

While studying Gerrit van der Sterre's "Four Centuries of Dutch Planemakers" (Primavera Pers, 2001), I ran across what the author calls a "raamtang" – Dutch for "window pliers." As you might guess, it is a joiner's tool used originally to hold narrow window sash bars for moulding.

The similarities between this entirely shop-made wedge-powered vise

and the screw-powered "Moxon" vise led me to make and try a raamtang with great success for other work.

Heart of Oak

There is a lot of force exerted on the jaws of a raamtang – so much that they often bend in use. To counteract this, I chose to make mine from strong white oak.

The version of the raamtang presented here is long enough to hold up to a 24"-wide panel and stock up to about 1½" thick. Feel free to make modifications to suit the scale of work you do in your shop, but this size works well for most furniture tasks.

Prepare your ¾"-thick wedge blank and mark out the angle, then saw the pieces apart and plane the sawn edge to a smooth surface.

I like to use about a 15° or 20° angle, but the exact angle of the wedge is unimportant because you will lay out the shoulder cut from the wedge. Just remember – a shallow angle will hold with more strength than a steep angle.

Strong Arm Tactics

Use straight-grained white oak for the arms. For the jaws, pick up some 6/4 white oak a little more than 4" wide.

Rough-plane both faces and pick the most attractive grain pattern to serve as the top side of the vise. After that, flatten that face with your try plane. This will serve as the reference face, so make sure it is as flat as you can make it.



Memory help. Plane the wedges to a consistent angle. This frees you from having to remember which wedge goes to which arm.





Square deal. Keep the stock of the square tight against your blanks while keeping the arm blank tight against the blade of the square.

Next, set a marking gauge to the thinnest dimension present between the two faces of the board and mark a line all the way around. Plane the board down to this thickness, but save the final smoothing until after you've chopped the mortises.

Joint the first edge of your board. When finished, this will serve as your reference edge for laying out the arm mortises. Mark out and plane the width of the board so that it is about 4" wide, then scribe a line on each face that is 2" from the reference edge.

Because you want the mortises in both arms to line up, lay them both out at the same time before separating the jaws with your rip saw.

Start by establishing the inside lines of the mortises so that they are 24" apart. Align the arms with those lines and mark out their width along the top face. Square these four lines down both edges using the top face for the stock of the square.

Open the Jaws

Now saw the jaws apart with your rip-saw. Place the separated jaws on your benchtop with the reference edge down, then square the sawn edges with your try plane, planing a slight crown on the inside edge of the rear jaw.

Square mortise lines down the sawn edges from the reference face. Finally, lay out a $\frac{3}{8}$ " x $\frac{3}{8}$ " rabbet along the top back edge of the rear jaw; this engages with the wedges and helps them stay aligned when you drive them into place.

Lay out and saw the angled cuts on the top of the arms using the wedges as templates. Next, scribe the $\frac{5}{8}$ " tongue, referencing the face of the marking



A tight grip. The slight crown in the rear jaw will provide maximum holding power near the center of the vise.



Lignin biceps. Here are the raamtang arms in their final shape.

gauge off what will be the bottom face of the arms. Rip the waste material away close to the line, then smooth the rough-sawn face of the tongue down to your line with planes and chisels.

Save the sawed-off waste to make the pegs that attach the arms to the front jaw. Finally, drill a pilot hole, then drive a rosehead nail into the center of the remaining thick portion to help prevent shearing this piece off in use.

Chop the Arm Mortises

Set a marking gauge to the thickness of the arm tongues so the fence is $\frac{3}{8}$ " away from the first tooth. Scribe the mortises

on both edges down from the top of the jaws. If you have a mortise chisel that fits the width, chop the mortises in both jaws working from each edge. Otherwise, bore a $\frac{1}{2}$ " hole, then pare the waste to the line.

Ensure that the arms fit tightly in the front jaw mortises but have a little play in the rear jaw. I like to use a rasp to open up the rear jaw mortises a little.

Bevel the outside edge of the front jaw. Plane a $\frac{3}{8}$ " x $\frac{3}{8}$ " rabbet along the top back edge of the rear jaw. Smooth plane the faces, then break all the outside corners on the jaws. Slide the arms through the rear jaw and into the front jaw. Line up the end of arm so that it slightly proud of the reference face.

Bore $\frac{3}{8}$ " peg holes through the fixed front jaw and the arms. Make two roughly rounded $\frac{3}{8}$ "-thick pegs from the arm waste you sawed away earlier.



Strike zone. I prefer to strike my mortise layout lines with a sharp bench chisel.



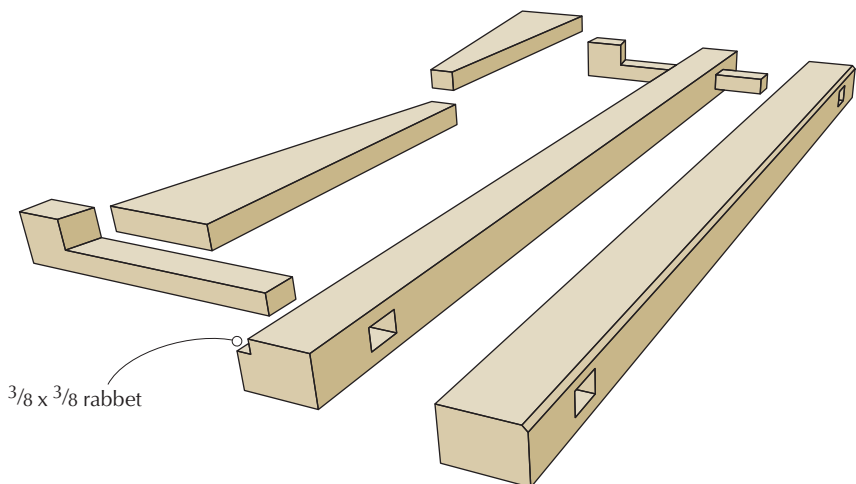
Smooth action. This arm has a nice loose fit through the rear jaw; this will enable the vise to work without binding.



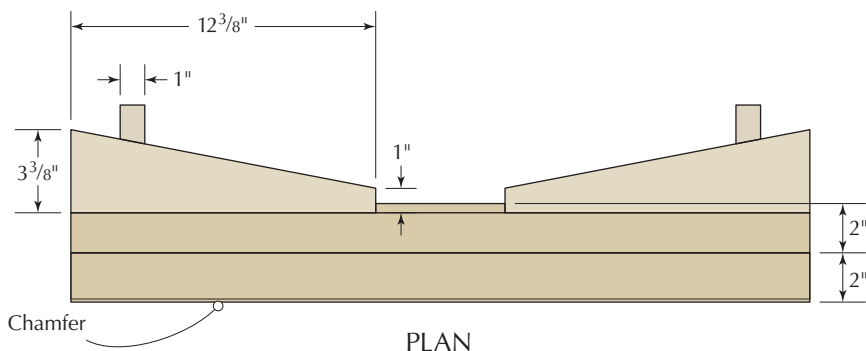
Line it up. Note that the bottom of the rabbet aligns with the top edge of the arm mortises.

Raamtang

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL	COMMENTS
		T	W	L		
2	Jaws	1 ³ / ₈	2	30	White oak	
2	Arms	1 ¹ / ₂	1	8	White oak	
2	Wedges	3/4	3 ³ / ₈	12 ³ / ₈	White oak	Taper to 1"



EXPLODED VIEW



PLAN

Check one final time to ensure that the rear jaw slides smoothly on the arms and make any necessary adjustments.

Finally, drive the pegs home into the peg holes and make any final adjustments to the wedges to ensure they hold tight. Give the entire piece a couple of coats of wiping varnish to complete the project.

"Character is like a tree and reputation like its shadow. The shadow is what we think of it; the tree is the real thing."

— Abraham Lincoln (1809-1865)
16th president of the United States

Using the Raamtang

If you've seen the Moxon vise in action, you are familiar with many of the things of which this type of vise is capable.

I have used the raamtang in conjunction with my holdfasts to dovetail case sides, a task at which it excels. I have also used it to help keep boards aligned while gluing them into wide panels.

This vise also is an excellent appliance to hold and support a workpiece while cutting a mortise; clamping along the outside helps prevent you from blowing out the side of the mortise with the chisel.

As you might expect, given that this was originally designed as a joiner's appliance (namely for holding window



Side action. Clamping the sides of the piece being mortised helps prevent cheek blowout.



Working out. Here's the task for which the raamtang was designed – holding small pieces of moulding for planing.

pieces for shaping), it excels at holding stock for moulding, rabbeting and even planing grooves.

When it comes to planing the saw marks off the back of a freshly stuck piece of hand-cut moulding, I've yet to find anything better.

It holds like a bear trap (especially with a bit of leather glued to the working faces), is simple to make and costs next to nothing if you use pieces from the scrap bin. What else can you ask for from a shop appliance? **PWM**

Zachary is currently at work on a book on 18th-century furniture (due out late in 2016 from Popular Woodworking Books).

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Mid-century Modern Bookcase

BY MICHAEL CROW

Simple joinery serves this sophisticated geometric design.

Mid-century modern design is enjoying a surge in popularity, and rightly so: Its clean lines and functional design make it practical and attractive, two traits evident in this bookcase by an unknown designer.

Its stark, geometric design shows modern roots while giving it a strong graphic presence. And because it looks good from both the front and back, it's perfect for dividing a space without completely partitioning it, making it a good match for the open-plan homes of the period, and of today.

Simple construction techniques underlie the sophisticated design: Rabbits in the leg assemblies capture the case, with its interior dividers and shelves joined by dados. The asymmetrical dividers are made from 1/2"-thick stock while the outer case is made from 3/4"-thick material. The legs and rails are 1" thick. The varying thicknesses, and a 1/2" reveal of the case in the legs, add another subtle detail to the design.

The original case was executed in rosewood, but I opted for cherry finished with oil and shellac. It provides a warmth similar to rosewood without the expense. Too, the design lends itself to a variety of materials, so pick your materials to suit your décor.

Following the original, I built the case from sheet goods (the legs and rails are solid cherry), but there's no reason to choose sheet goods over solid wood. While plywood does require





Edge-banding two ways: clamp and caul, or use masking tape. For either approach, make sure your banding is wide enough to stand slightly proud of both faces of the board.

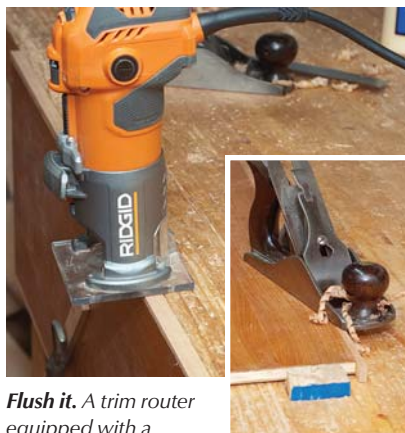
edge-banding, you'll likely spend the same amount of time gluing up narrower solid stock to produce the wide boards required for the project, so let your preference and working style guide your choice of material.

Edge-banding Two Ways

Because it simplifies cleaning glue squeeze-out, I prefer to pre-finish my parts when a design allows it. That's the approach I took here for the case interior, wiping on a coat of boiled linseed oil, followed by padding on a couple of coats of blonde shellac.

Rip the $\frac{3}{4}$ " and $\frac{1}{2}$ " plywood to $10\frac{1}{4}$ " (which allows for $\frac{1}{8}$ "-thick edge-banding on both sides to produce $10\frac{1}{2}$ "-wide panels). Then apply the boiled linseed oil and first coat of shellac. With the panels ripped and pre-finished, you're ready for edge-banding.

You can use commercial veneer tape and iron it to the edges of your plywood, but ripping your own banding gives you enough thickness to round or chamfer your finished edges. That looks nicer, and it makes the banding blend better with the sheet stock.



Flush it. A trim router equipped with a flush-cutting bit makes quick work of trimming the edge-banding – but so can a block plane or smoothing plane (though you need to take care to avoid gouging the thin veneer face).

While it's tempting to set the fence for a narrow cut for ripping, you'll avoid the risk of the narrow stock jamming in the throat plate if you position the fence to produce a strong $\frac{1}{8}$ " offcut, and reset the fence after every pass.

After ripping my banding, I planed one face smooth for gluing, then applied it to my plywood. I sized the edge of the plywood by brushing on a thin layer of

glue, letting it sit for a minute for the long-grain plies to absorb glue, then applying another thin coat before aligning the banding to the sheet-good edges.

You can use a clamp and cauls to secure the banding while the glue dries, or you can use masking tape, scraping away any glue squeeze-out after it gels.

Once the glue is dry, cut the banding flush with the plywood. A trim router equipped with a flush-cutting bit is designed for this work. The hand-tool alternative is a sharp plane set for a shallow cut.

Dados Join the Interior

The case interior is joined with $\frac{1}{4}$ " x $\frac{1}{4}$ " dados, stopped about $\frac{1}{2}$ " from the edges of the boards. A simple plywood jig (shown below, left) guides the router for making these cuts.

Mark the location of the dados, align the cut in the fence with your marks, position the router, plunge and plow. Note that where two shelves line up on either side of a divider, the dados will cut all the way through the plywood, leaving solid stock only at either end of the cut.

Take care when handling the unassembled $\frac{1}{2}$ "-thick dividers to avoid breaking the workpiece – or set your router a little shallow for these cuts, then trim the corresponding tenons to fit.

Tenon the ends of the interior parts with a rabbeting bit (router) or dado stack (table saw), then notch the ends of the boards for the stopped dados. You'll need to round over the tenons or square the dados with a chisel to get the parts to fit.



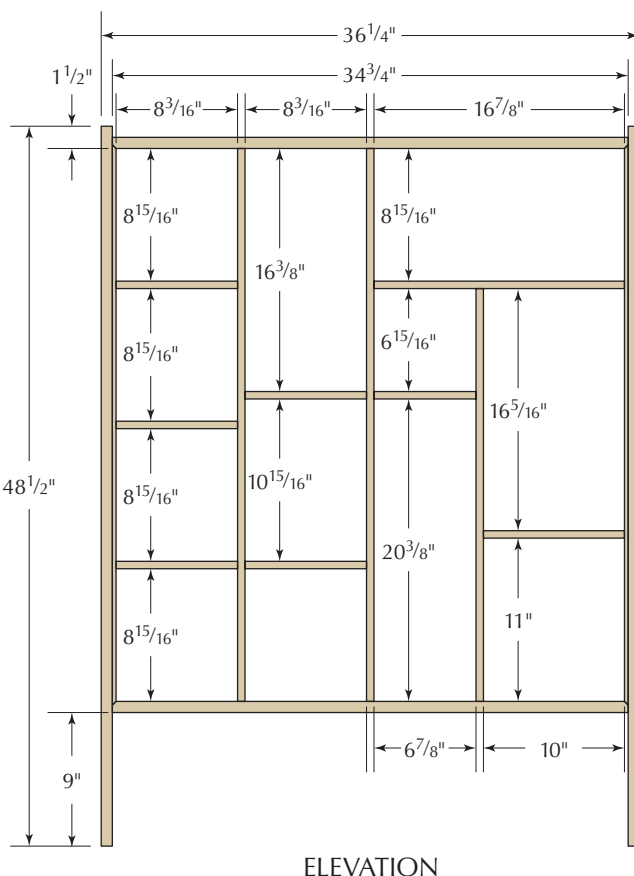
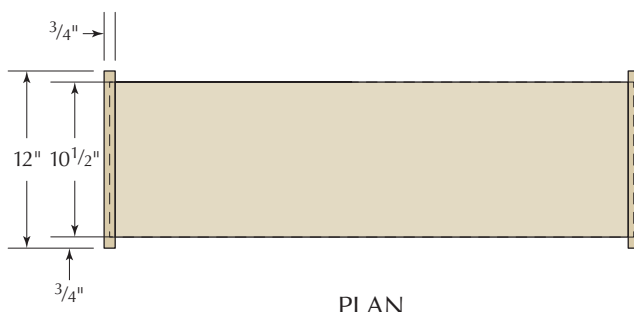
Easy dados. This simple jig holds the router base in position and guides it while cutting stopped dados. Align the bit at the start of the cut ($\frac{1}{2}$ " in from the edge), plunge, then plow.



Router tenons. I used a router with a rabbeting bit to cut $\frac{1}{4}$ "-thick tenons on the divider and shelf ends.



Perfect miters. A simple plywood fence clamped flush with the end of the board guides the 45° chamfer bit (take multiple passes) for clean miters. The fence should extend past the edges of the board, and the inside edge of the board should face up.



"The simple joy of taking an idea into one's own hands and giving it proper form – that's exciting."

—George Nelson (1908-1986),
American designer

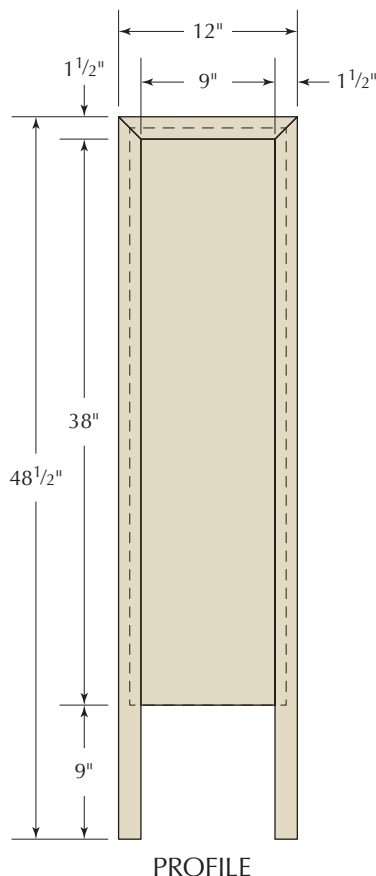
Mid-century Modern Bookcase

NO.	ITEM	DIMENSIONS (INCHES)			MATERIAL
		T	W	L	
❑ 2	Case bottom/top	3/4	10 1/2*	35 3/4	Plywood
❑ 2	Case side panels	3/4	10 1/2	38 3/4	Plywood
❑ 1	Long shelf	1/2	10 1/2*	17 3/8	Plywood
❑ 1	Medium-long shelf	1/2	10 1/2*	10 1/2	Plywood
❑ 5	Medium shelves	1/2	10 1/2*	8 11/16	Plywood
❑ 1	Short shelf	1/2	10 1/2*	7 3/8	Plywood
❑ 2	Tall vertical dividers	1/2	10 1/2*	37 3/4	Plywood
❑ 1	Short vertical divider	1/2	10 1/2*	28 5/16	Plywood
❑ 2	Side frame rails	1	1 1/2	12	Cherry
❑ 4	Legs	1	1 1/2	48 1/2	Cherry

DRAWER

❑ 1	bottom	1/4	6 3/8	9 1/2	Plywood
❑ 2	Front/back	3/4	6 7/8	6 15/16	Maple
❑ 2	Sides	1/2	6 15/16	10	Poplar

*Includes 1/8"-thick solid edge-banding on both edges



Cut the Miters

Miters join the case. I used a length of plywood as a fence to guide a large 45° chamfer bit to cut these joints with a router. Simply position the fence along the end of the board, set the bit for a 3/4"-deep cut, and rout the chamfer, easing up to the final depth with multiple passes. Cut and miter the case sides now, but leave the ends a little long until after you've dry-fit the case. Doing so allows you to size the pieces for perfect fit.

The frame assembly pieces are also mitered, but these can be cut with a miter saw. If your stock is long enough, cut each assembly from a single board so the grain runs continuously around it.

Rip the parts to width, cut your miters, then cut the legs to final length.

Size the ends of the boards before gluing and clamp in both directions across the joint, taking care that the boards align and the miters stay tight. When the glue is dry, rout a stopped 3/4"-wide x 1/2"-deep rabbet for the case, then square the ends of your cut with a chisel.

Assemble in Stages

Assembling the case is a bit like putting together a jigsaw puzzle. I built the case from left to right in stages. Join the first series of dividers and shelves and let



Staged assembly. Assemble the case in stages, building from one side to the other. After the first section is glued up and dry, the second series of shelves and the divider are glued to the first sub-assembly. And so on.

MINIMALIST DESIGN: MAXIMUM STYLE



In the middle of the last century, a new generation of designers sought to render furniture to its most essential forms – and in doing so, defined mid-century modern style. The piece shown here is among those in Michael Crow's new book, "Mid-Century Modern Furniture: Shop Drawings & Techniques for Making 29 Projects" – available now at ShopWoodworking.com.

DECORATIVE DRAWER

With its prominent placement, the drawer creates a strong focal point for the design of the case – so it's a great place to express yourself.

Do you have a special piece of stock or veneer you've been saving? What about that custom wooden pull you've been wanting to try out? Or Greene & Greene-style finger joints? The drawer's small scale makes it the perfect place for experimentation.

I used some figured maple and created a simple wooden pull, then coved the edges to create a shadow line. Half-blind dovetails join the drawer box, and the plywood bottom is glued into a rabbet.

—MC

Drawer details. After cutting the drawer front to size, I drilled a clearance space for fingers at the drill press, then chopped a mortise to house the pull. After coving the edge with a router, I glued in the wooden pull.



that section dry before adding the next series. Finally, size the miters and glue the ends to the case.

Once the assembly is out of the clamps, level its hardwood faces with a smoothing plane or sander and ease the edges of the boards. Now's a good

time to smooth and finish the leg assemblies, too. Glue them to the case, taking care to remove squeeze-out after the glue has gelled, then finish the outside of the case.

With the case and drawer complete, now comes the hard part: deciding what deserves pride of place on your stylish new bookcase. **PWM**

Michael is the author of "Mid-Century Modern Furniture: Shop Drawings & Techniques for Making 29 Projects."

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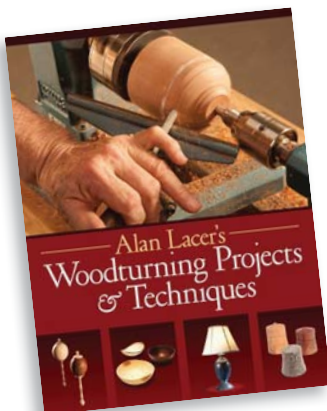
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A Father's Legacy

The lessons learned didn't stop at the shop door.

Christmas, 1956. I was a little fella, and my seeing the Tonka Hi-Way series display in the W.T. Grant store months earlier had captured my entire attention.

In my letter to Santa, I asked for the Tonka set. What I didn't know was that my folks had already put the set in lay-away at Grant.

After I'd settled down some with my bright orange Tonkas, I noticed a little box made of red oak with brass hinges and a snap closure on the front.

The aroma of dad's shop and red oak filled my nose as I opened the box. And inside that box, three tools for dad's little apprentice—a level, a plumb bob, and a square. Just like dad's, except sized for my little hands.

I remember just holding them, as if they were precious metals or jewels, so much so I was hesitant to touch them. Dad explained each tool and what each meant and how they were used.

April, 1973. My dad died. He was only 55 years old. A master shipbuilder for the U.S. Navy and a master furniture maker no longer graced this world.

I was a junior in college at the time, and my journey was carrying me to a career in health care; what some might think is far from working wood.

When I arrived home on April 5, after spending time with my mom, I went to "our" shop. I turned on the light—dad had been in there late on April 4, fixing something for mom, and I thought maybe, just maybe, something of dad remained.

A cool rain fell outside, and I realized that even the shop appeared different. Maybe I just felt lost, until I walked to dad's bench.

On the benchtop were the large versions of the tools I'd received on Christmas Day 1956, plus one more



— the compass. I completely lost any composure I had, and I just wept.

And then, I heard dad's voice from across time, as he'd said many years before, the real meaning and use of these tools: "Use these tools to help the less fortunate."

His reminding me to "measure thrice and cut once," and "pay attention to everything," were just as clear as when he first told me such things.

All these years later, making tools each day in my shop is my reminder of what I was taught about focus, commitment and desire—and of Tonka trucks (which I still have).

My shop drips with tool history, including my dad's "apprenticeship Navy Gray" tool chest he made in the summer of 1941 as an apprentice ship's joiner for the U.S. Navy and inside it, all the tools he used.

As I was taking photos of dad's chest for this essay, I found a small compass at the bottom—a Starrett #85 compass, with a pencil attached by my father decades ago. A bit of cleaning revealed his initials—"J.A.D."

I've never found the little toolbox I received in 1956. But the real gifts dad

gave me weren't in that little box anyway. Those little tools only represented the true sacred nature of things, and I believe that's exactly what my dad wanted me to know. And after serving the sick and broken, and then teaching such things for 40 years, I realized two things: 1) I had used the tools to serve the less fortunate; and 2) I'm now able to make such tools.

Thing is, though, legacy is not just the tools I have that belonged to my dad. It's far deeper. It's about those skills I've learned and developed in my own journey. Like my dad often said: "Tools make a master not; skills, strength of heart and focus do." **PWM**

Joe, who lives in Lebanon, Va., is owner of DiPietro Toolworks and is the former director of Cardiopulmonary Sciences at Southwest Virginia Community College.

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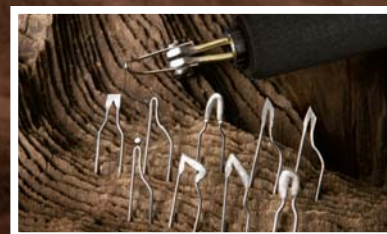
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